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THE PSYCHOLOGICAL REVIEW.

PSYCHOLOGY AND PHYSICS.[1]

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The honor that you have conferred upon me in electing me to the presidency of the Association is one of which I am very sensible, and one that I shall not misprize to the extent of addressing you upon the details of experimental matters with which so far I have been chiefly engaged. I have therefore chosen as my topic some of the more general aspects of psychology and its relations to one of the other sciences, and given my paper the title that stands upon the program.

I have two chief points to make: (1) That psychological theory is influenced to a large, and perhaps at times to an embarrassing, extent by points of view and forms of expression derived from the physical sciences, and (2) that even in spite of this fact psychological theory is, and perhaps cannot well help remaining, distinctly anthropomorphic in its nature.

First then as to the influence of physics on psychology. A part of this influence is due not so much to the science of physics as to the fact that man dealt long with the outer world before he made much progress in introspection, and even now spends a considerable portion of his time in that sort of commerce. As a result his habits of thought are in large degree objective, and the language that he uses is saturated with physical connotations and metaphors. One need only recall the broadly material character of most of the forms of popular

[1] President's address, American Psychological Association, Washington meeting, December, 1902.

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spiritualism to perceive what tricks this may play with the unwary. And indeed it is not easy for even the best of us to keep clear of this inveterate physical-mindedness and the subtle suggestions of language. We help out our thinking by material figures and feel a sort of dumb compulsion to make our psychological theories accord with physical requirements. Ebbinghaus notices the first of these tendencies in his address on the past hundred years of psychology before the last International Congress.[1] After describing the older psychology as distinctively 'mechanistic,' he continues: "Mental phenomena are connected with material processes; in order, one may suppose, that the difficult exposition of the first may take its bearings from our familiarity with the second, in other words, from the natural sciences. Of these Physics and Chemistry first won an assured completeness of content and method, and thus many physico-chemical analogies came to be influential in the older psychology. The return of images passed for a phenomenon of like nature with inertia, association was set parallel to attraction, the ego became an aggregate of ideas, spatial perception a chemical combination of sensations." This state of things continued in the ascendent, though not uncriticised, well on into the century, as witness the works of the two Mills, and the Herbartian mechanics of ideas; and even now "the color theory of Helmholtz and Wundt's space theory are comprehensible only on the basis of an essentially physical manner of thinking. Perhaps the last remnants of such manipulation of things by means of mechanical categories is even yet not overcome, but in essentials one may venture to say that Psychology has outgrown it. We realize that the soul is connected with the body, in particular with the nervous system. If material analogies and explanations are used for mental combinations they are drawn from the special elaborations of physico-chemical processes that we call physiological or biological. Here chiefly it is the notion, originated by Darwin and Spencer, of a development of the mental life, both as a whole and in its single aspects, like that of biological evolution, that has become the controlling and fruitful one for us."

[1] 'IVe Congrès international de Psychologie,' Paris, 1900, pp. 58 f.

Ebbinghaus is right, no doubt, and most psychological investigators are now sufficiently independent, at least in the immediate conduct of their investigations and in the extraction of their first generalizations. In the discussion of psychological theory, however, and especially in the borderland between Psychology and Philosophy, the influence of other sciences has not wholly disappeared, but on the contrary seems often to remain to make trouble for those who cross the border from the psychological side. I have in mind particularly the doctrine of the psychophysic parallelism and the assumptions upon which it rests. I do not propose to discuss this in detail — especially as to-morrow's program promises the treatment of it by several of our colleagues most expert in such questions — but I would ask you rather to review the field with me from an exclusively psychological point of view, and to see whether a restatement of the problem in purely psychological terms does not throw some light upon it.

Before beginning, however, let me beg your indulgence while I try to anticipate two possible misconceptions. First, in what I am going to say I have no thought whatever of disparaging the other sciences or of belittling their importance or even their helpfulness in psychological investigation. On the contrary I hold them in the highest estimation, and believe the legitimate debt of psychology to them to be enormous. The criticism, if any is implied, lies against psychology and psychologists, not against other science or scientists. And second, I have no thought of recommending a new point of view from which to prosecute psychological investigation. Quite the contrary. I do believe, however, that a purely psychological point of view is a valuable one to take upon occasion in considering questions of psychological theory and of the interrelations of Psychology and the other sciences. As a traveler through the woods may now and then find it advantageous to climb a tree and look about him to discover the general direction of his path, or even for the mere enjoyment of the aspect of things from a new point of view, and yet would not, except under dire necessity, attempt to continue his journey like a monkey or squirrel direct from tree to tree, so I beg you to take for a few moments

a position from which things may be viewed in somewhat different relations from that in which they appear in the paths of ordinary reflection and investigation.

Our common working position is that of a double series of phenomena, a physical series in the world about us and a psychical series within us. Höffding divides the universe into two parts and gives one to Physics and one to Psychology.[1] "These two provinces," he says, "include everything that can be the subject of human research;" and psychologists generally, when in a working and not in a critical or contentious frame of mind, would raise no objection. When, however, we take the exclusively psychological point of view, we shall want to say that Psychology, as the science of conscious states and processes, has to do with all experiences of every sort whatsoever. Even those aspects of experience that we commonly call physical, if they are noticed at all or become in any degree matter for reflection, take their place *ipso facto* among conscious experiences and thus become appropriate matters for psychological investigation. From this point of view Höffding was much too modest; he should have claimed the universe entire. The other sciences then become but separate departments of psychology, sciences of special aspects of conscious experience. Physics is engaged in discovering the uniformities running through the group of psychical experiences that have to do with bodies in movement and at rest, with heat, light and electricity; Chemistry in discovering those that have to do with the composition of bodies, the nature of the elements and the laws of their composition; Biology with the group of experiences connected with living organisms; and similarly with all the other sciences of nature. Mathematics and Logic are still more intimately psychical, dealing as they do with certain actual or possible forms of thought in symbolic representation. All the phenomena dealt with by each and every one of the sciences, their laws and general formulas, and the ultimate philosophical conceptions to which they lead, are one and all conscious experiences and as such fit matter for psychological examination.

[1] 'Outlines of Psychology,' London, 1893, p. 1.

This is not idealistic metaphysics, though I confess that there are certain resemblances, and that an idealistic philosophy follows as naturally from an exclusive contemplation of psychical facts as a materialistic one from a like concentration upon the facts of the physical sciences. It is not metaphysics at all, but a simple description of the facts. Conscious states exist; they are all of them, and no others, the subject matter of psychological science, at least in the broad sense in which we are now using the term. What I am saying holds equally well with materialistic, idealistic or dualistic conceptions of ultimate reality. I am dealing exclusively with conscious experience, and such an exclusive point of view is equally possible with all. Furthermore, the legitimate distinctions between the sciences are not obliterated by regarding them in this way. All differences remain as from the beginning except that their terms of statement are changed. Even the difference between Psychology and Physics is not removed, as I shall hope to make clear presently.

But first let us look a little closer into Physics from our ultra-psychological point of view. The conscious experiences with which Physics starts (physical phenomena, as we commonly call them) are percepts or series of percepts belonging chiefly to the sense fields of sight, hearing and touch, including under the latter the kinæsthetic senses as well as pressure, heat and cold — the senses that mediate the 'life of relation' with the world outside our own bodies. For convenience I shall call them the 'physical group' of senses. Certain characteristics of these senses can be traced through all the elaborations and abstractions of physics up to and including the most remote. Taste, smell, pain, the general and organic senses — all having little external reference — are not mentioned at all in physics, or at most incidentally, as supplying certain supplementary data. And even among the physical senses themselves all are not of equal importance. Theoretical physics tends more and more to construe all phenomena in mechanical terms; and sound, heat, light and electricity are studied as varieties of wave motion. The special sense qualities fall into the background and the phenomena are restated in the terms derived from the senses capable of perceiving matter in motion, the kinæsthetic and a

part of the dermal senses and vision in its spatial function. No physicist would be materially hindered in the prosecution of researches in any branch of his science by the lack of smell, taste, pain or the general and organic senses. One without kinæsthetic and dermal senses, on the other hand, would find the science itself well-nigh inconceivable. This only means that for physicists as for other men these senses are those of last resort in matters relating to the external world.[1]

But the sensory basis of Physics is not the science itself. The science is the superstructure of generalizations, laws, hypotheses and theories, which have arisen in the effort of physicists to reach a simplified conception of the experiences occurring in the sense fields just mentioned. These in their finished form are generalized verbal descriptions of physical phenomena (*e. g.*, "every particle of matter in the universe attracts every other particle," etc.) accompanied in some cases, perhaps, by a more or less typical image. In this verbal form they are conveniently remembered and serve many useful purposes. They represent nothing more, however, than the final stage of a process of abstraction from phenomena actually observed or reported, and, as Ribot so ably demonstrates,[2] owe what value they possess to the possibility of a return from them to concrete phenomena. The concrete phenomena to which the physicist returns when he is pressed to make his law of gravity concrete are a group or sequence of images derived from the physical senses. He imagines again the falling ball, the swinging pendulum, the moon and planets in their orbits — whatever may at the moment best serve his purpose — or he actually sets up his apparatus and gives ocular demonstration of the law. He drops the ball and measures the spaces passed over in equal times, proving in the particular case the steady acceleration due to gravity. From our ultra-psychological standpoint once more the original phenomena are all of them percepts or series of percepts; and the more or less abstract formulations, leading

[1] Physiology, which is really a special branch of Physics and Chemistry, has to do with these senses and all the rest in a somewhat different way from that which we have been considering; to that I shall refer later.

[2] 'Evolution of General Ideas,' Chicago, 1899, p. 110 and elsewhere.

up to the concise verbal statements of physical laws, are convenient symbols, standing for the original perceptive experiences. A physical law and its possible concrete examples is a sort of fixed associational complex, or, as Charles Peirce might have called it, a habit[1] — or as we might say, a special habit of thought with reference to conscious experience of a particular kind.

This is true not only for the ordinary laws of physics but also for the still more general and abstract principles of the permanence of matter and the conservation of energy, for these differ from the ordinary laws in nothing but their abstractness and in the tremendous sweep of their application. They exist in the mind of the physicist as an abstract form of words. If he is pressed to make them concrete or if he applies them, they show nothing but certain coincidences or groups or sequences of sensory images or percepts. The permanence of matter means only that as a result of a certain series of percepts the same original percepts with which we set out may be reached again. We hand a chemist a silver dollar. He dissolves it in acids and forms a solution from which he presently obtains precipitates. These he treats variously until at length he presents us with a little button of silver and another of copper which we can take to the mint and get recoined as a silver dollar again. In the same way the conservation of energy means that at the end of a certain series of percepts the same grouping of percepts from which we set out may be reached again — the same quantitatively in all particulars of state and arrangement.

And the same is true finally with the ultimate matter and energy themselves. Matter has the qualities of impenetrability and extension and betrays by its conditions and behavior the presence of various forms of energy. These qualities are allowed it because they characterize the original physical percepts from which the concept is derived. They are the skeleton that remains after all non-essentials have dropped away. Even if the concept is still further refined and atoms are conceived as without substance — mere centers of attraction

[1] 'Illustrations of the Logic of Science,' *Popular Science Monthly*, XII., 1878, p. 291.

and repulsion — these very attractions and repulsions are so accorded them that they give rise to the original sensations underlying perceptions of extension and impenetrability. And energy in its various forms: Kinetic and potential, heat, light, energy of molecular condition, radiant energy, electrical and magnetic energy — all of them betray their presence by the changes they produce in matter. In other words they are abstractions from experience of various sorts within the field of the physical group of senses — abstractions that have proved useful in the effort to unify these experiences. Indeed I may conclude as I began, by declaring that from the ultra-psychological standpoint Physics is a most elaborate development of one aspect of the Psychology of the dermal and kinæsthetic senses — a most interesting and valuable study of fixed associative groups of a limited sensory origin.

It is time that I justify my remark that this ultra-psychological point of view does not remove the legitimate differences between Psychology and Physics. The method of Psychology is in its broad outlines not essentially different from that of Physics. Its phenomena are conscious experiences of various sorts, including all those with which Physics sets out, but also along with them experiences involving pain, organic and general sensations, feelings, emotions, memories, images, volitions, processes of reasoning — indeed everything in experience at all. The generalizations of Psychology, like those of Physics, are abstractions of varying degrees of refinement, generally used in verbal form, but convertible on demand into terms of concrete experience. The characteristic difference lies in their standpoints or attitudes. Even in dealing with the same original experiences with which Physics deals, Psychology selects somewhat different aspects and looks for a different set of uniformities. These different standpoints or attitudes are themselves, in psychological terms, differences in the direction of attention with all that implies.

The mighty gap which has sometimes been assumed to separate the realm of Physics from that of Psychology is thus seen to be of no very extraordinary nature. It is an arbitrary separation made for convenience and not worthy to excite

special admiration. One might as well express surprise over not being able to pass by insensible gradations from *A* to *not-A*, or from one territorial jurisdiction to another, as over finding no place of transit by easy stages from things physical to things mental.

A second point of difference is the greater variety of experience covered by Psychology, Physics dealing with what we call outer experiences only, Psychology in our present sense with both inner and outer. As I have tried to show, Physics comes at last to work with terms derived exclusively from the kinæsthetic and parts of dermal and visual experiences. Generalizations derived from these sense fields can never fully explain experiences belonging to other fields, because of the difference in sense modality. One cannot describe or explain a taste in terms of vision nor general sensations in terms of moving particles. The same is the case with the more complex experiences involving sensations not of the physical group.

A third difference — not an essential one, but one fraught with manifold practical consequences — is the greater simplicity of physical experiences. This gives them a great hold upon the imagination and is one of the reasons for the dominating influence of the physical sciences, of which I spoke in beginning.

Psychology itself, as it appears from our ultra-psychological point of view, deserves a little consideration. In many cases Psychology is able to trace fairly well-connected sequences in its special aspect of experience, *e. g.*, in the members of a practiced train of mnemonic associations; but in others it is not able to do so. Among experiences of all grades instances occur in which, so far as we can see, the antecedent condition does not at all account for the phenomenon that develops. Let us take some concrete examples. I see a boy touch a lighted match to a rocket, which presently goes off with a hiss, and leaving a train of fire, bursts in a shower of stars which sink and disappear. In such a series there is no break. The statement from our present point of view would be simply that we had experienced a series of percepts beginning with the touching off of the rocket and ending with the disappearance of the falling stars. The psychical series of experience differs from the physical series only in the aspect regarded, and each member

of the series is a sufficient reason for the presence of the next. The case is not so simple when attention is otherwise directed and the new sensation bursts in upon an unrelated series — if, for example, when seated in revery, I hear a sudden explosion out of doors. There is now nothing in the conscious train to introduce the sudden sound; as far as that is concerned, the sound is wholly unaccountable. To leave it unaccounted for is to admit just so much chaos into the mental world, and we therefore relate it forthwith to some other order of occurrences independent of our consciousness, in which it may be lodged safely between antecedent and consequent—in other words, we assume the physical series.

It is not absolutely necessary that we identify this needed independent series with the series coming to us through the physical group of senses — we might assume some sort of an 'unconscious'; but the intercurrent experiences generally come to us through one or the other of the physical senses; the physiology of the senses makes the connection seem close; and we make it readily because at other times we have followed with attention a full series that led up to a similar explosive sound; we have seen the boy touch a match to the fuse of the fire cracker, have seen the spark creep along the fuse and finally heard the report. We assume that something similar has happened again, though we were not there to see, and we say the sound was due to an external stimulus; and, extending the idea, arrive finally at an independent external world constantly in existence and frequently furnishing us with sensations by means of stimuli administered.[1] This assumption is, as I have said, in the nature of a theory or hypothesis, like the atomic theory or the hypothesis of an ether, and has the same sort of justification — the only possible justification, other than immediate conscious experience — to wit, that it harmonizes an immense number of facts and has not met an irremovable exception.

In an entirely similar way, wholly unrelated ideas at times break into our trains of thought or revery. Often in such cases

[1] I am here speaking of the logic of the thing, of course. As a matter of fact the whole system of the outer world is built up and in use in the mind of the child long before he ever introspects or takes consciously any theoretical attitude toward his experience at all.

more careful examination shows some unnoticed association or intruding sensation to account for the break, but there are some cases where no such explanation is discoverable and they remain inexplicable in psychical terms. In such cases we find it necessary to appeal once more to the activity of something outside the conscious series, and we speak of 'unconscious cerebration' or simply of 'the unconscious.' In the case of these higher psychical processes our knowledge is less perfect and the connection with the physical series is less patent; consequently we feel the compulsion less strong to identify our hypothetical unconscious series with the physical series. As our knowledge of cerebral physiology increases we shall probably find the tendency increasingly greater, and we shall speak less of 'the unconscious' and more about 'unconscious cerebral processes.'

Let no one think we have a quarrel against these assumptions. We have none; they are useful and we are forced to make them. We only desire to recall once more that the physical series which they assume is based upon the physical group of sensations and has been elaborated according to the usual psychical processes of perception, association, abstraction and generalization.

What we have just been considering has brought us to the problem of the relation of mind and body, one which I believe has been obscured — at least as far as psychological theory is concerned — by the preponderance of forms of statement and points of view derived from the physical sciences.

The problem as it appears from our purely psychological standpoint is simply this: How can we best utilize the physical series that we have been obliged to assume? And the natural answer seems to be the assertion of some sort of interaction. The physical series must influence the psychical series or it will not fulfil the purpose for which it was assumed. And the psychical series must influence the physical, if we are to explain the cases of voluntary movement, where we can follow distinctly a psychical series leading up to a predictable physical result. For psychology as a natural science, the hypothesis of interaction seems quite sufficient.

That this seems to run counter to the physical principle of the conservation of energy, is in itself no greater argument against the theory of interaction — provided that that theory is otherwise the best from the psychological point of view — than it is against the principle of the conservation of energy itself. That principle was reached from the consideration of a certain group of facts; it is by no means necessary that it should apply when other facts are brought into consideration. It is possible that we may in the end strike some form of conception that shall show that the theory of interaction contains no real denial of the principle of the conservation of energy — perhaps on the lines of the 'genetic modes' of our colleague, Professor Baldwin,[1] or along the line suggested in Dr. Bawden's paper before the Philosophical Association,[2] perhaps in some one or other of the other suggestions that have been made. Bnt in the meantime it seems to me a crying example of the over-reverence for physics of which I am speaking, that a physical principle should be cited as an objection to a psychological one otherwise valuable.

The current answer to the problem is, as everybody knows, not interaction, though that has been supported by the brilliancy of both James and Stumpf, but that of the psycho-physic parallelism in its various forms. That this theory, which is surely not so natural and simple as interaction, should be the current theory of the day is not to be accounted for by reasons lying in the province of psychology. The mere assertion of the parallel (with the implication that the two series are independent) and no further explanation of the nature of the relation, is distinctly inferior to interaction. It makes necessary the assumption of all kinds of unconscious actions, or interferences of some sort, to account for the above-mentioned irregularities of sensation and reflection, while it gets no corresponding advantage. Very often the parallels are not thought of as independent, but a greater permanence and reality is attached to the physical side. It is asserted that there is no psychical action without action in the

[1] 'Development and Evolution,' N. Y., 1902, pp. 300 ff.

[2] 'Proceedings of the First Meeting of the American Philosophical Association, 1902,' *Philosophical Review*, XI., 1902, p. 270.

higher cerebral centers, but the counter proposition, that there is no action in the higher cerebral centers without psychical action, is denied. The currency of the theory in this form is due, I believe, to the glamour of the physical sciences. I agree entirely with our colleague, Professor Münsterberg, that the determination of standpoints on this question rests upon extra-psychological considerations,[1] and I believe that it is in the predetermination of these considerations that the influence of the physical sciences is most exercised.

So much for my first point, to which I have perhaps given too large a portion of my time. My second was that Psychology is an essentially anthropomorphic science (and I should say here, parenthetically, that I am now using the word Psychology in the narrow and ordinary sense, and the word 'anthropomorphic' in contra-distinction to mechanical). I doubt if any one would contest the proposition. Just as Physics retains to the end certain characteristic features of the sense fields in which it originates, so we may expect Psychology to bear the marks of its derivation from conscious experience as we know it. In normal adult psychology the anthropomorphism is too much a matter of course and too little disadvantageous — indeed too fully justified — to be much noticed, but one has only to open his eyes to realize its anthropomorphic character. This indeed might not be worth notice were we not tempted beyond the bounds of introspection to enter upon comparative psychology. Are we justified in using our own psychical experience as a basis of interpretation with reference to the behavior of animals, very little children and the feeble-minded? Were it not better if we declined to go beyond the immediate facts of observation and were content with a purely objective science of animal or child or idiot behavior? Such a course might be possible, but I doubt if any one has ever seriously contemplated it in the case of the higher animals, or could carry it to fruitful results if he should undertake it. Nor would any one seriously propose to treat the behavior of his fellow men in the same way, *i. e.*, to refuse to credit them with conscious experience in the main like

[1] *Grundzüge der Psychologie*, Bd. I., 402 ff.

his own, though this would seem to be required logically, unless one can show an essential difference in the conditions under which he judges of human and animal activities. The fact is that as soon as actions become at all complicated the concept of mechanism breaks down. It does not simplify the phenomena, nor unite them without violence with other groups of phenomena. It loses therefore the only justification which it ever had, namely its usefulness. Another concept and this the anthropomorphic one (*i. e.*, interpretation in terms of human experience) makes the facts observed more intelligible, and enables us to group them in larger unities and thus establishes its propriety. Our justification in assuming a psychic life of some kind in animals or little children or low idiots is of the very same nature as our assumption of a material world which furnishes the excitants of sensation, or of the mechanical principles that govern its phenomena — of the same kind, though less certain of course, because the facts covered are more complex and less easy to observe.[1]

I trust that no one will understand me as holding that because we must cast our conceptions of the psychic life of animals in human terms we need do so rawly, and in the identical terms in which we experience our own. By no means. Exactly as the theoretical mechanics of the physicist is not the mechanics of any particular body, but an abstraction of the features common to all mechanical phenomena, so our ultimate psychoses must be the fundamental ones common to all conscious experiences. Just what these ultimate psychoses ought to be we are perhaps not fully ready to say, but we seem to require a sensory awareness, colored by original liking or disliking and a tendency of these sensory impressions to remain for a brief period. This simple consciousness must also be effective in some way in altering existing tendencies to movement.

How far down in the animal series this shall be assumed to go is purely a question of utility in thinking, and can be settled

[1] It is perhaps worth noting in passing that those who argue from experiments on animals that cerebral changes induce psychical changes, are not in a position to deny the existence of psychical experiences to animals.

only by gathering facts and trying to explain them. It will be conceded that the hypothesis of some sort of mind in animals is required at the upper end of the scale; it is equally conceded that a mechanical explanation may suffice at the lower end of the scale — though conservative biologists would perhaps regard it as probable rather than proved. Usefulness in thinking must decide where the line shall be drawn, or if the two series—psychical and physical—must be assumed to act conjointly throughout.

This assumption of mind in animals almost inevitably draws after it some form of belief in interaction. It is hard to believe that consciousness has not been a helpful possession in the evolution of man and higher animals, and if so it must have made his behavior different from what it would have been if consciousness had not existed. I do not insist upon this point, however, lest some one accuse me of introducing Biology into psychological theory when I cast out Physics.

This anthropomorphic character of Psychology stands in sharp contrast with the mechanical tendency of Physics. In the wider conception of Psychology which I used in the first part of my address, the mechanism of Physics would have to be included as a partial aspect of the general anthropomorphism but with the narrower and current definition of the science the distinction is radical. The ultimate perfection of psychology is reached in an abstract consciousness in which state follows state according to known laws, that of physics in an abstract mechanism in which everything is formulable in terms of moving particles. Neither anthropomorphism nor mechanism, though growing steadily more refined and abstract, can lose its essential quality and yet serve its purpose. The former must carry the marks of its derivation from human introspection; the latter of its origin in the physical senses. For this reason no attempt to explain experience in physical terms can ever be thoroughly satisfying, nor one that tries to get rid of the necessary assumption of the physical series. Any philosophical system that hopes to pass from the ultimate principles of science to a satisfying grasp of all phenomena must treat both these ultimates with equal favor.

A STUDY OF THE RELATIONS BETWEEN MENTAL ACTIVITY AND THE CIRCULATION OF THE BLOOD.

BY FREDERICK G. BONSER,

University of Illinois.

The purpose of this investigation is threefold. The first problem concerns the changes in the rate and force of heart beat and the vasomotor fluctuations concomitant with agreeable and disagreeable sensations and affective states under conditions of mental acuity and fatigue. The second treats of these differences as connected with processes of intellection during the progression to a state of mental fatigue. The third is a consideration of the vasomotor rhythm, indicated by the Traube-Hering waves, in relation to the acuity of sense perception observed to recur in rhythmic regularity.

In consideration of the admirable historical review of observations relevant to the subject of this investigation made by J. R. Angell and H. B. Thompson,[1] a review of the literature would here be superfluous.[2] The results and conclusions of former investigators will be considered wherever it is desired to make statements of comparison.

I here take the opportunity to acknowledge my indebtedness to Dr. Edwin Grant Dexter, professor of education in the University of Illinois, under whose general direction this study has been made; to Dr. Stephen S. Colvin, assistant professor of psychology in the University of Illinois, and the several students who have acted as subjects for experimentation; and to Dr. John A. Bergström, of Indiana University, under whose di-

[1] PSYCH. REV., VI., pp. 32–43.

[2] Publications since the issue of the above study make possible the following additions: Wundt, *Philos. Studien*, XV., 140. Wundt, 'Völkerpsych., I., II., 1900, 40 ff. W. P. Lombard and W. B. Pillsbury, *Amer. Journ. of Physiol.*, III., 186–201. A. Lehmann, 'Die körperlichen Aeusserungen psychischer Zustände, I., Plethysmographische Untersuchungen,' Leipzig, 1899.

rection preliminary experiments on phases of the same problem were made, which furnished the inspiration for the present investigation.

Apparatus and Experiments.

A continuous kymograph, highly adjustable with respect to speed, designed and made in the laboratory of the department, was used for taking tracings. A chronograph indicated a seconds time tracing. Marey tambours, to which were attached inking cups and capillary pens drawn from glass tubing, were used to produce the tracings on white paper. For continuous records this method has many advantages over smoked paper tracings.

Both the time-rate of the pulse and the vasomotor changes in the peripheral blood vessels were recorded by the use of the

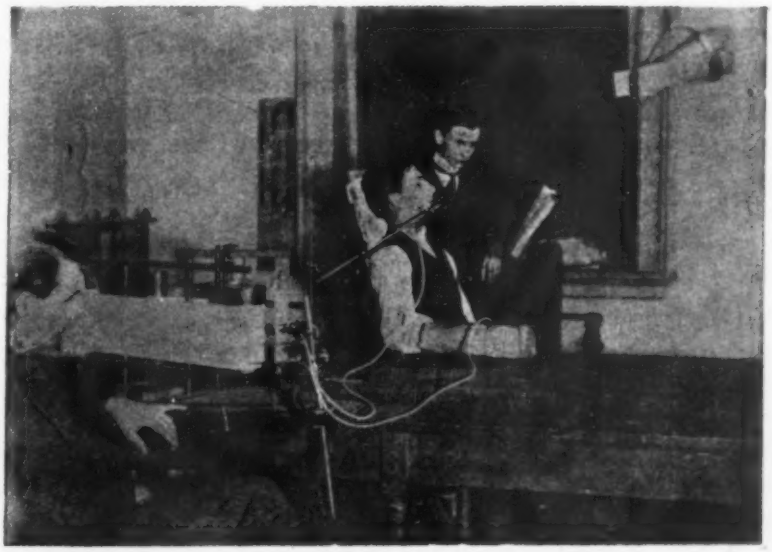

FIG. 1. Apparatus used in taking simultaneous sphygmographic and plethysmographic tracings.

plethysmographic tracings, save in a few cases where sphygmographic records were taken directly from the carotid. The air plethysmograph was used. Most of the records were taken from the forearm, but a few were from the foot. For the tests

involving fluctuations of attention, a tambour giving the tracing was placed in connection with a press bulb. The stimulations used were visual and auditory. An audiometer was used for the latter as much more satisfactory than the ticking watch; for visual stimuli the Masson disc and geometrical figures were used. Extended experimentation was required before the most suitable speed of kymograph, the most desirable temperature of the room, the best quality of rubber, the proper manipulation of the pens and the most satisfactory position of the body were secured.

The series of records upon which this paper is based consists of the results of extended and complete tests taken from twelve subjects. For the long records the subject remained in the chair with the apparatus attached for from forty-five to sixty-five minutes. For the tests in responses to emotional states and brief intellectual application, the subject was taken at a time of mental acuity, before the prolonged task was begun and again after the completion of the hour's vigorous work.

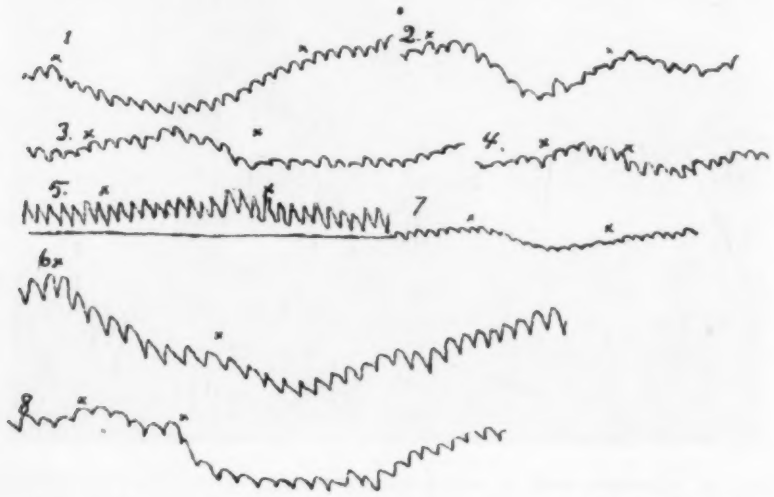

FIG. 2. Curves 1, 2, 3, heliotrope; 4, 5, crab apple; 6, 7, 8, carbon bisulphide.

Explanation of Figures. All curves read from left to right. The application of a stimulus or the solution of a problem begins at the point marked with a cross, terminating at the second cross. A drop in the curve indicates vasoconstriction; a rise, vasodilation.

Many records were taken from the twelve subjects, and also from others, which were not used. Wherever, through any error in adjustment or working of technique, question arose as to the validity of tracings, they were thrown out. Careful tests have assured me that the accuracy of the curves used may be fully relied upon as indicating changes in the rate and volume of the blood flow to the parts used in the experiment and to show the character and amplitude of the capillary pulse.

I. Affective States.

The emotional states here considered were all produced by agreeable or disagreeable odors. Curves 1 to 5 are tracings of agreeable odors; 6 to 10, of disagreeable. All these are plethysmographic except 5 and the upper curve of 9. In these the rate of heart beat during the emotion varies with the vasomotor changes of the peripheral blood vessels. Vasodilation is accompanied by an accelerated heart rate and vasoconstriction by a diminished rate. In every case constriction occurs, although constriction is preceded by dilation in curves 2, 3, 4, 11 and 13. This is most marked in 3, taken from B., and in 9 and 13, from D., these subjects invariably showing this effect, regardless of the character of the emotion. In subject B., constriction was never very evident, either in emotional or intellectual activity.

It has been held by Féré[1] that agreeable experiences are accompanied by dilations of the capillary blood vessels and disagreeable experiences by constrictions. Alfred Lehmann[2] agrees with this, and Wundt[3] has embodied Lehmann's conclusions in his *Völkerpsychologie*. No other investigators have found any foundation for these conclusions. I find that all emotional experiences are accompanied by constriction, either immediately or after brief dilation. For most individuals, normal vasomotor recovery is more rapid after an agreeable experience than after a disagreeable feeling. Compare curves 1 and 6.

It may be noted that the vasomotor activity of the peripheral vessels precedes, in some cases, the constriction or dilation of

[1] 'Sensation et mouvement,' Paris, 1887.
[2] 'Hauptgesetze d. mensch. Gefühlslebens,' tr. by Bendixen, Leipzig, 1892.
[3] 'Völkerpsychologie,' i, I., 1900, 40, ff.

the carotid. (See curves 9 and 18.) This suggests the question of control of the blood supply to the brain, a question as yet having received no completely satisfactory solution. The view of Mosso[4] that the blood supply to the brain is a condition and not a cause of psychic activity finds support in these curves.

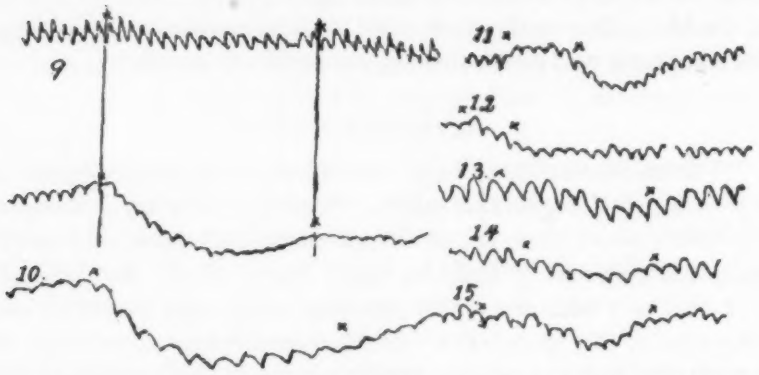

FIG. 3. Curves 9, 10, carbon bisulphide; 11, 13, carbon bisulphide before work; 12, 14, 15, same after one hour's work. Upper curve in 9, from carotid.

This question will be discussed further in the last section of the paper.

Curves 11, 12, 13, 14, 2 and 15 show the effects of fatigue upon the circulatory responses to emotional states. Curves 12, 14 and 15 are tracings for the application of the same stimuli as in curves 11, 13 and 2 respectively, after one hour's rigorous mental activity. The effects of fatigue are shown in the greatly diminished amplitude of pulsations, the diminished heart rate, the diminution in vasomotor response to stimulation, and the greater retardation in the recovery of the vasomotor level.

II. INTELLECTUAL ACTIVITY.

The tests employed in these experiments for intellectual activity were mathematical problems for the short periods, and memorizing or reading difficult subject matter for the prolonged records. Curves 16 to 21 are plethysmographic tracings for problems in addition and multiplication. In every one of these vasodilation precedes constriction, and in all the heart rate in-

[4] 'Die Ermüdung,' p. 195, ff.

creases during the period of vasodilation. In all excepting 16 the amplitude of the pulse curve is diminished. Curves 19 and 20 were taken from subjects M. and B. respectively, whose records for almost every test given of any kind failed to show any marked constriction, where it was shown being preceded by dilation. This was especially true of B., further shown in curves 27 and 28. It is to be noted, however, that the amplitude of the pulse curve is greatly reduced and the heart rate is quickened, indicating an increased blood pressure.

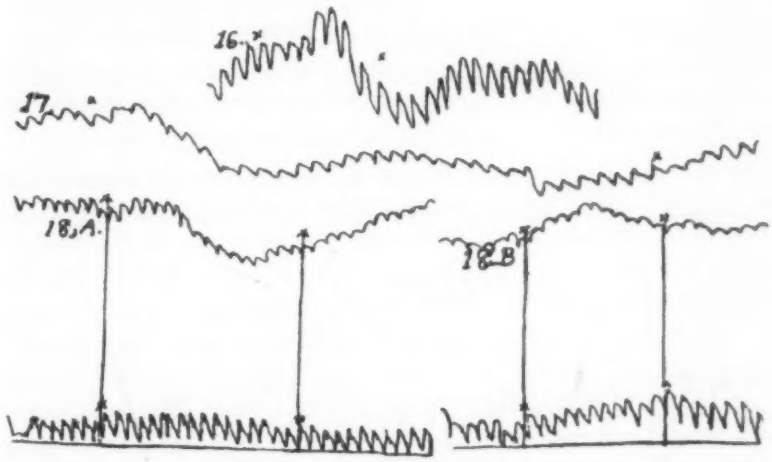

FIG. 4. Curve 16, addition; 17, multiplication; 18, both A. and B., addition; in 18, lower curve from carotid.

Curves 22 to 24 are from the carotid. So also are the lower curves in curves 18, A. and B. All these excepting 23 show vasodilation and all of them show diminished amplitude of pulse curve, indicating an increased flow of blood under a greater arterial pressure. Curves 22 and 24 also show clearly that the dicrotism of the carotid pulse is much less acute. The dicrotic notch is almost obliterated during intellectual activity in curve 22. These results are quite the opposite of those of Gley[1] who found that mental work increases the amplitude of the carotid pulse and accentuates the dicrotic notch. Binet and

[1] 'Etude expérimentale sur l'état du pouls,' etc. Paris, 1881.

Henri[1] agree with the results here given in finding an increased blood pressure during intellectual activity.

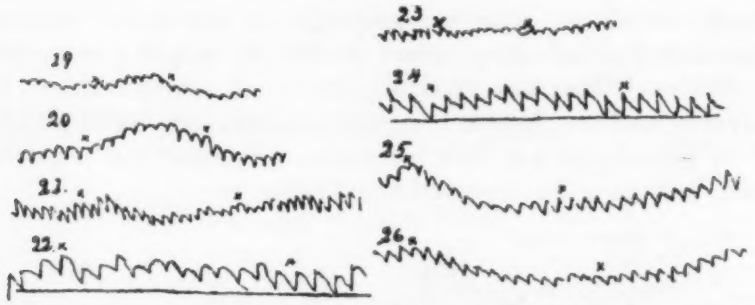

FIG. 5. Curves 19, 20, 21, multiplication; 22, 23, addition, from carotide; 24, multiplication, from carotid; 25, addition, before work; 26, same, after one hour's work.

The tracings for intellectual activity given by Angell and Thompson[2] show far less vasomotor response than do the ac-

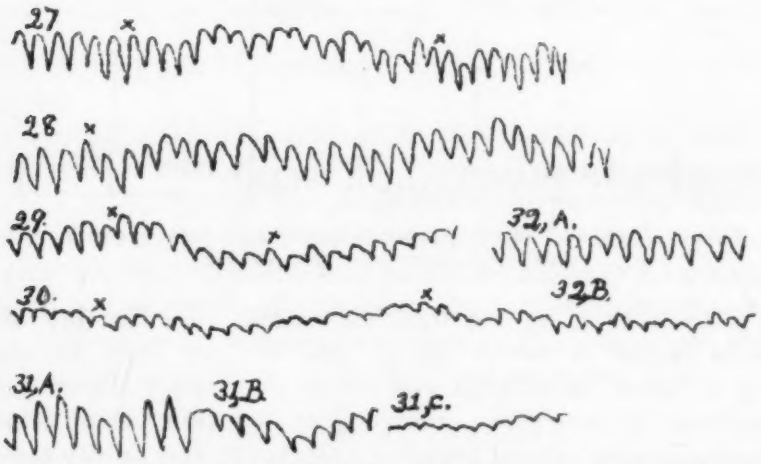

FIG. 6. Curves 27, 29, multiplication, before work; 28, 25, same, after one hour's work; 31, A., before work; B., in fortieth minute; C., in sixtieth minute; 32, A., before work; B., in sixtieth minute.

companying curves. They also point out a regularity and stability in the circulatory processes concomitant with intellec-

[1] 'La fatigue intellectuelle,' pp. 112, 113.
[2] *Ibid.*, pp. 61, 63, 64.

tual activity much greater than that observed for emotional activity.[1] The accompanying curves fail to show any such differentiation. These differences in observations emphasize the fact that there are great individual differences in subjects. The equivocal character of the literature on this subject may be very largely due to the individual variations, no previous investigator having employed a sufficient number of subjects to realize the necessity for caution in generalizing.

Curves 25 to 30 show the effects of fatigue on the circulation in its responses to intellectual activity. Curves 25, 27 and 29 represent short mathematical problems before work was begun by the subjects. Curves 26, 28 and 30 indicate problems of the same degree of difficulty by the same respective subjects after one hour's rigorous mental application. The subjects remained in the chair during the hour with the apparatus attached, a continuous tracing being recorded. In no cases are records here compared which were taken at different sittings. Not only are differences in physical and mental states in the subject so great as not to admit of comparison, but it is not believed that adjustments of apparatus are possible which will insure tracings susceptible of valid comparison as to absolute dimensions. In these three sets of tracings, fatigue is evident in the greater time required for the solution, in the diminished rate of heart beat, in the diminished amplitude of the pulse curve and in the reduced vasomotor response to the intellectual stimulus.

Curves 31, 32 and 33 are plethysmograms, and 34 and 35 are sphygmograms showing the progress of fatigue. Curve 31, A., at the beginning of work, B., in the fortieth minute and C., in the sixtieth minute, indicate the diminished heart rate and pulse amplitude through one hour's continuous work. Curve 31, A., before work, B., in the tenth minute, C., in the twenty-fifth minute and D., in the fortieth minute, show both the diminished pulse rate and amplitude, and the changes in the dicrotic notch through forty minutes of close mental application. Curves 34 and 35 show these diminutions in rate and amplitude, and more clearly the changes in the dicrotism of the pulse through forty minutes rigorous mental work. Fig. 7 indicates clearly the

[1] *Ibid.*, p. 67.

effects of fatigue on both the capillary pulse and the carotid, curves 34 and 35 each being carotid tracings, while 33 is from the forearm. The loss of acuteness in the dicrotic notch is

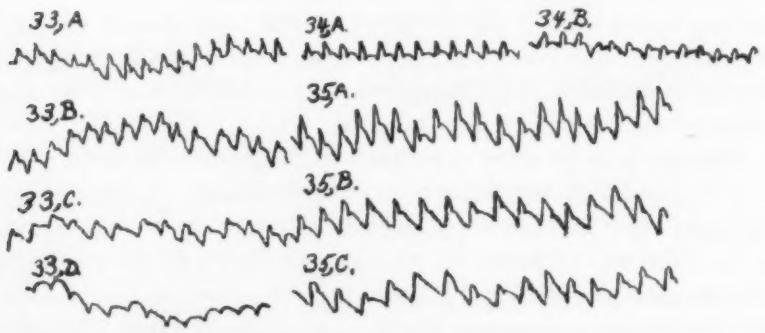

FIG. 7. Curve 33, A., before work; B., in the tenth minute; C., in the twenty-fifth minute; D., in the fortieth minute; 34, A., before work; B., in the fortieth minute; 35, A., before work; B., twenty-fifth minute; C., fortieth minute; 34, 35, from carotid.

plainly evident in both, but the anacrotic effects are most fully developed in the capillary tracings.

Figs. 8 to 11 give reduced records of plethysmographic tracings, showing both the heart rate and the vasomotor fluctuations through periods of from forty minutes to sixty-five minutes. The records show conditions at intervals of one minute. In these figures the numbers at the top and bottom of each line indicate in minutes the progress of the experiment. In every case the upper record in each figure is based upon the rate of heart beat. The lower record indicates the vasomotor fluctuations. The numerals at the right and left of the pulse-rate curves express the number of beats of the heart each minute; those at the right and left of the vasomotor record show the height of the curve in the tracing in millimeters.

Binet and Courtier[1] are the only observers who have made similar tests for long periods of time. Their experiments were with two subjects and covered periods of five hours. Tests were taken at intervals of about one hour, the apparatus being removed after the test and the subject retiring to an adjoining

[1] 'La fatigue intellectuelle,' p. 97.

room. The validity of the comparison of records taken under such circumstances is open to question. In continuous records the fluctuations vary from two to twenty millimeters in vasomotor level. Short tracings taken at intervals of an hour might show either extreme of these variations. The movements to the

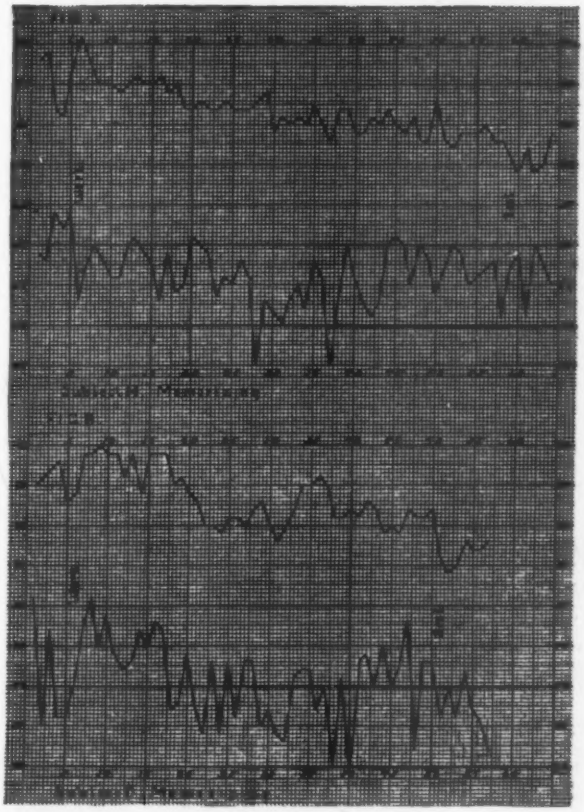

FIG. 8. Prolonged intellectual application. Upper curve in each figure for heart rate, lower for vasomotor changes. Numerals at top and bottom of each figure indicate minutes of progress; at the right and left of the upper record the heart rate per minute, of the lower record the height of the tracing in millimeters.

room and for the adjustment of the apparatus, together with the mental relaxation occasioned by these movements, would introduce possibilities of additional error, all of which are obviated

by the continuous records. As to the rate of heart beat, two types of records are found. Those shown in Figs. 8, 9, and curve E, of Fig. 10, indicate the one form in which the rate progressively diminishes under intellectual activity, or diminishes for a considerable time, then remains approximately the same for the remainder of the hour. Fig. 8 shows the former

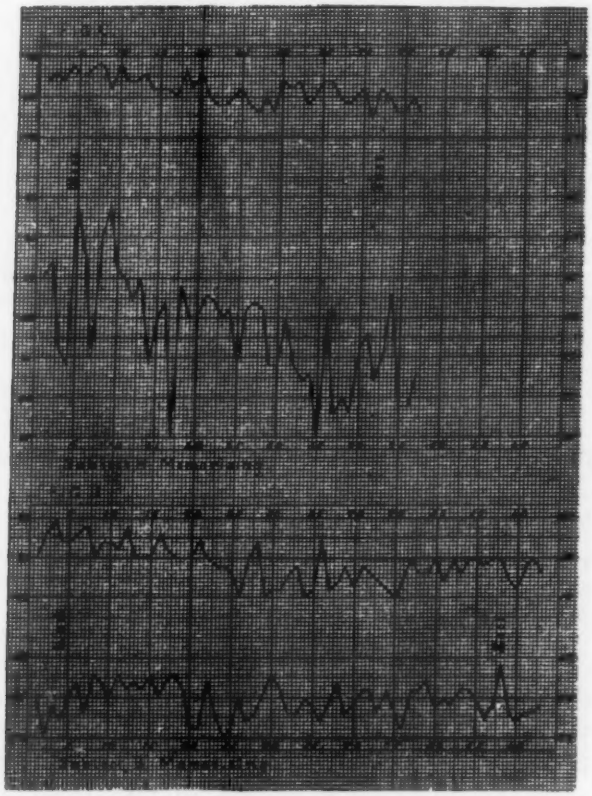

FIG. 9. Prolonged intellectual activity. For explanation see FIG. 8.

condition, curve D, of Fig. 9, the latter. The second type is shown in curve F, of Fig. 10, and in Fig. 11. Here also two forms occur, curve F illustrating the first, a general rise in the rate until the close of the hour. Fig. 11 shows the other form, in which there is an increased rate for a considerable period then a diminution.

In curves A and B, the fall is steady, after the short rise at the beginning, from 94 beats a minute to 80 in the former and from 89 to 76 in the latter. In curve D, Fig. 9, the rate drops from 82 to 75, then at the forty-sixth minute rises and remains

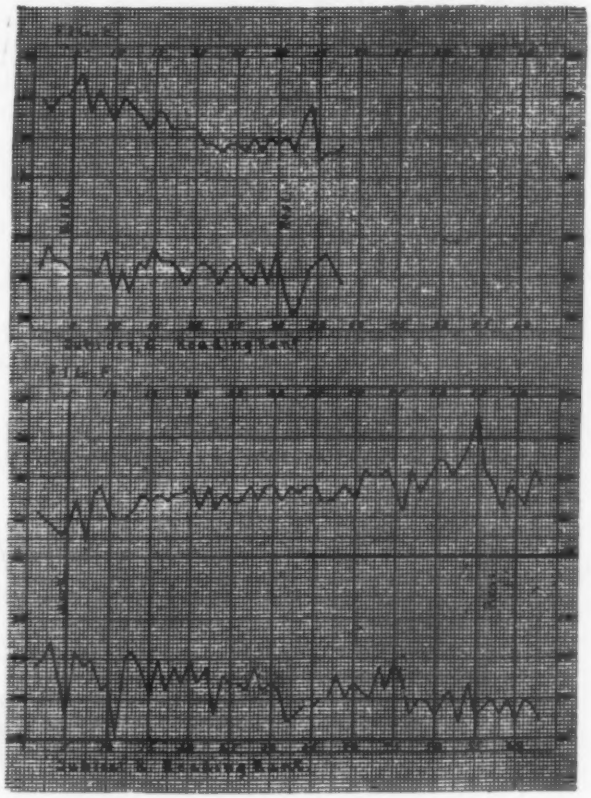

FIG. 10. Prolonged intellectual activity. For explanation see FIG. 8.

at or near 80. In curve F, Fig. 10, the rate rises from 58 to 65, takes a sudden rise to 73 in the fifty-fifth minute, then falls back to 63 at the close of the hour. Curve H, Fig. 11, shows a rise from 81 to 86 by the thirty-fifth minute, then a fall to 81 again by the end of the hour.

The fluctuations in the vasomotor records are much greater than those in the rate of heart beat. The records in Fig. 8 and curve C, of Fig. 9, indicate a type in which the vaso-constric-

tion increases until about the fortieth minute, then slightly diminishes for the remainder of the period. Curve D, Fig. 9,

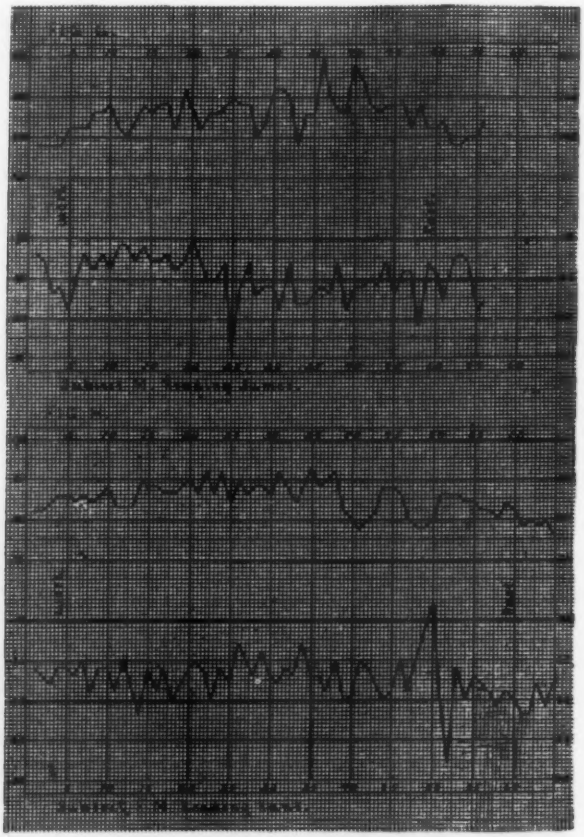

FIG. 11. Prolonged intellectual activity. For explanation see FIG. 8.

and curve H, Fig. 11, show the type in which there is no progressive vasomotor activity. In curve D, after a slight dilation, constriction bringing the curve down to the resting level follows, and slight fluctuations in both directions recur at intervals of from two to four minutes through the hour. In curve H, there is a gradual dilation up to the thirty-fourth minute, then a progressive constriction for the remainder of the period. In curve F, the constriction is continuous and progres-

sive through the hour, the curve falling from a height of 44 millimeters to 37, as measured on the tracing.

Curves A, B and F show a tendency toward recovery in the increased heart rate, and curves A, C, G and H, in vasodilation, during the short period of rest recorded at the close of the intellectual labor. But recovery from such prolonged and intense application is too slow to be very markedly evident in the first few minutes of relaxation. Fluctuations in both the records for the pulse rate and for the vasomotor level are rhythmical, the periods varying from one to three minutes. There is also a correspondence observed between the two rhythms. In general, an increase in vasoconstriction for one or two minutes is followed by an increase in the rate of heart beat. This correspondence is confined to short periods of time, however, for most subjects. One record only is found where the parallelism is continuous and progressive through the long period, curve F, Fig. 10, showing this for fifty-five minutes

W. H. Howell[1] found that the blood pressure begins to diminish in a subject sitting for a sleep record as soon as he is comfortably seated, and continues to diminish for from an hour to an hour and one half.

Prolonged intellectual activity produces the opposite result. curves 31, 32 and 33 clearly indicate the progressive increase in blood pressure. How long it might continue to increase it is beyond the province of this investigation to state.

III. The Traube-Hering Rhythm and Fluctuations of Attention.

During periods of rest or after the subject had become absorbed in concentrated study, long undulations, covering the time of two or three respiration periods, appeared with great prominence and regularity in the tracings of a number of individuals. The time of these wave-lengths corresponds fully with the periods of the Traube-Hering blood pressure waves and the changes in amplitude of the parts of the wave indicate the blood pressure changes. Therefore the term Traube-Hering is be

[1] *Jour. of Exp. Medicine*, II., p. 319.

lieved to be valid as applied to these undulations and is used when they are referred to. Types of these waves from five

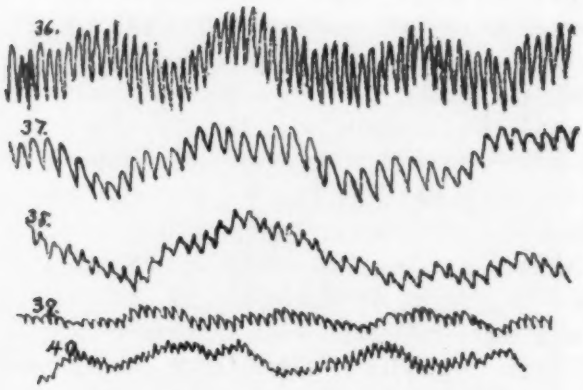

FIG. 12. Types of Traube-Hering Waves.

different subjects are shown in Fig. 12. The parallelism of the waves from the arm and foot is seen in Fig. 13.

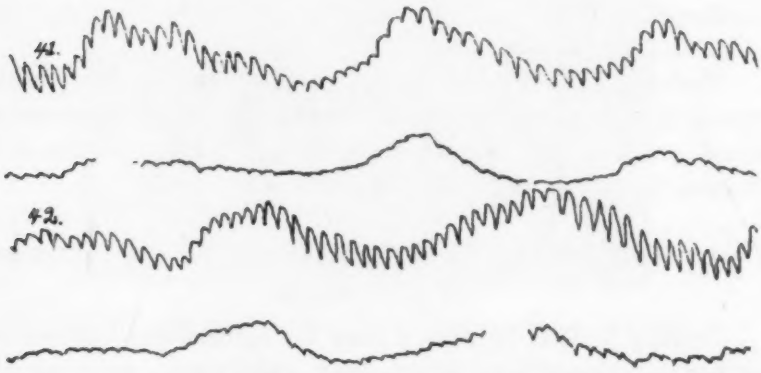

FIG. 13. Showing Parallelism of Arm and Foot Plethysmographic Tracings. Lower Tracing from the Foot.

The agreement of these wave lengths with the periods of rhythmic variations in the acuity of auditory and visual perception observed in the use of the Masson disc or the audiometer suggested that there might be a causal relation, or at least a constant correspondence between the two. Tests were made

with the results shown in Figs. 14 and 15. Curve 43 is a tracing recording the appearances and disappearances of the

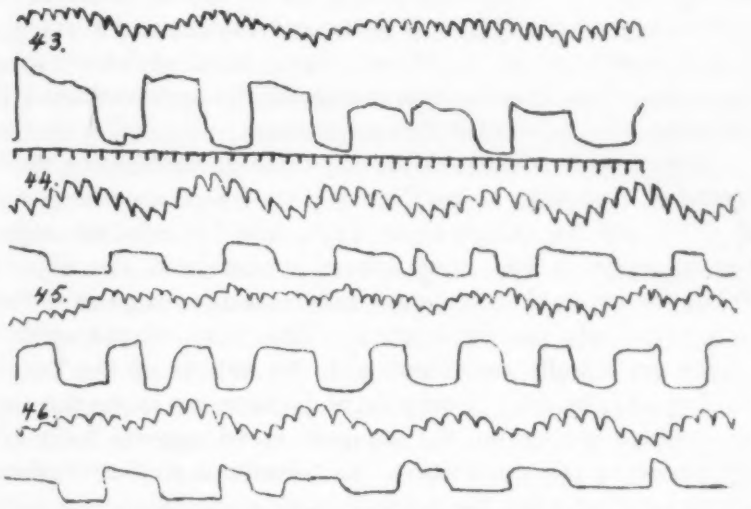

FIG. 14. Parallelism of Traube-Hering and Attention Waves. Curve 43, Masson Disc ; 44, 45, 46, geometrical figure.

gray ring in the Masson disc. Curves 44, 45 and 46 show the changing appearance of a pyramidal figure from convexity to concavity and *vice versa* by three different subjects, each con-

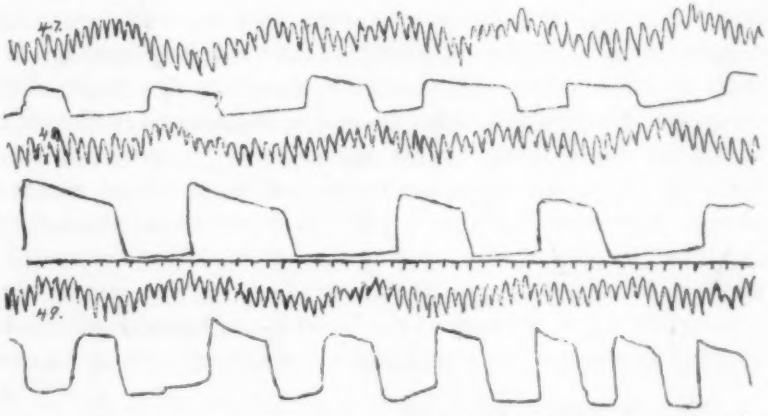

FIG. 15. Parallelism of Traube-Hering and Attention Waves. 47, Retinal-rivalry; 48, Audiometer ; 49, Masson disc.

sciously attending to the convex appearance. Curve 47 is a tracing for retinal rivalry, attention being directed to the image on the right eye. Curve 48 is a tracing for the appearances and disappearances of sound by use of the audiometer, and curve 49 a record from the use of the Masson disc. In all of these tracings the crests of the attention waves indicate the appearances of the sensation, the valleys the disappearances.

The possible relation of the rhythmic fluctuations in the intensity of sensations to the Traube-Hering waves was expressed by Roy and Sherrington[1] in 1890, but, hitherto, no experimental evidence has been offered to establish this relation. While the waves do not always fully coincide, in general there is a very close correspondence. The crests of the attention waves are usually coincident with the valleys of the Traube-Hering undulations. Using the audiometer set at the threshold of auditory perception, the minimal sound appears soon after the period of vasoconstriction; it increases until the maximum is reached just after the beginning of vasodilation and is lost near the middle of the curve's ascent.

The most recent and complete investigation of the causes of the Traube-Hering waves is that by Lombard and Pillsbury.[2] Their conclusion is that these waves are caused by a rhythmic activity of the vasomotor center. They found a quickening of the heart during vasoconstriction and a diminution during dilation. But the accompanying curves very markedly show the reverse of this. The quickening of the heart begins at the moment of vasodilation and continues almost to the crest of the wave, when a diminution begins and is maintained to the valley of the following wave. This agrees with the results of Binet and Courtier,[3] who made some observations on these waves in 1895. This also confirms a general observation which is exemplified in Figs. 2, 3, 4 and 5, namely, that when vasodilation precedes constriction, regardless of the mental state accompanying it, the rate of the heart is quickened until the beginning of constriction; and that when constriction is immedi

[1] *Journal of Physiol.*, XI., p. 108.
[2] *Am. Journ. of Physiol.*, III., pp. 201–228.
[3] 'L'année psychologique,' 1895, p. 124.

ately occasioned by a mental state, the pulse rate is diminished until the beginning of dilation. In curves 41 and 42 especially, and in 38 and 39, the diminished amplitude and reduced rate of the pulse are clearly evident during vasodilation. The same may be noted in curves 3, 9, 19, 20 and 24. Bayliss and Hill,[1] in a study of cerebral circulation and blood pressure, conclude that 'cerebral circulation passively follows the changes in the general circulation.' The above facts lend support to this view and to the conclusion that the circulation of the brain is controlled through the action of the vasomotor center acting upon the splanchnic area in governing the rate of heart beat and upon the vasomotor nerves controlling the peripheral circulation.

Why mental states should produce vasoconstriction in some subjects and vasodilation in others can not be answered in the light of present knowledge. In either case the fluctuation in the general circulation provides for an adequate blood supply to the brain—in vasodilation by an increased heart rate and a heightened blood pressure—in vasoconstriction by a diminished volume of blood to the periphery.

Summary of Results and Conclusions.

Both emotional states and intellectual activity are accompanied by change in heart rate and blood pressure in all individuals, and by vasomotor changes of the peripheral vessels in most persons.

In general, a quickened heart rate is concomitant with vasodilation, a slower rate with vasoconstriction.

The only constant variation observed in the tracings for agreeable, as distinguished from disagreeable experiences, is a tendency toward more rapid recovery to the vasomotor level in the former.

Intellectual fatigue is accompanied by a diminished vasomotor response to emotional states, and recovery is much slower than during mental acuity.

Prolonged intellectual activity produces a diminished amplitude of the pulse curve, an increased blood pressure and a diminution in the acuteness of the dicrotic notch. In most sub-

[1] *Journ. of Physiol.*, XVIII., p. 357.

jects a diminution of the heart rate occurs during the progress of an hour's mental activity, but in a few the rate is increased for this period.

In prolonged intellectual application, three types of vasomotor effects are noted: one of progressive constriction; one of no progressive vaso-changes, and one showing progressive constriction for a certain period then continuing at that level or showing slight vasodilation for the remainder of the hour.

A rhythm of from one- to three-minute periods is observed in both sphymographic and plethysmographic tracings. In general there is a tendency to coincidence in rhythm, a vasodilation being concomitant with an increased heart rate.

In most subjects during states of mental regularity and stability, as in repose or continuous intellectual application, the Traube-Hering waves are clearly defined in the tracings.

The pulse rate is quickened and the amplitude diminished during the period of vasodilation in the progress of the wave, the rate lowered and the amplitude increased during vasoconstriction.

These Traube-Hering undulations correspond in wave-length with the fluctuations of acuity in visual and auditory sense perception, the greatest acuity occurring just after the maximum of vasoconstriction.

The correspondence of vasomotor activity and heart rhythm, the response of the splanchnic and peripheral vasomotor activities to cerebral activity, and the evidence that the cerebral circulation is varied in consequence of changes in the systemic circulation, support the conclusion that the blood supply to the brain is controlled through the action of the vasomotor center. This is effected through irradiations to the splanchnic area which governs the rate of the heart beat and to the vasomotor nerves which control the peripheral blood flow.

DIRECT CONTROL OF THE 'RETINAL FIELD': REPORT ON THREE CASES.[1]

BY PROFESSOR GEORGE TRUMBULL LADD,
Yale University.

In the PSYCHOLOGICAL REVIEW for July, 1894, I gave a brief report of certain experiments made with a view to determine the answer to this question: "Can the sensations customarily called 'retinal,' which arise with the eyes closed and motionless, be made to respond to volition with respect to the form and color which they assume?" These experiments were instituted with a graduate class of sixteen members — all of them entirely capable of conducting and accurately reporting such observations. Of the sixteen only four reported no success; nine had a partial but constantly increasing success; while the remaining three attained speedily to very remarkable results. These three soon found themselves able to determine at will, within the limit set by the experiment, the shape of the visual phenomena; and, as well, the color — the color being sometimes so vivid that, on opening the eyes upon a sheet of white paper the proper complementary after-image promptly appeared.

These phenomena which I then regarded as exceedingly suggestive and, when taken in connection with numerous allied experiences, as necessitating an almost-complete change in our theory concerning the functions of the retina and the relation of visual sensations to centrally initiated conative impulses, have, so far as I am aware, received far less attention that they merit. I have myself been unable to pursue further the investigation. But there have since been handed to me three reports of self-experimentation which I consider well worthy of submitting to the Association, with the remark that they are all by trained students and successful teachers of psychological subjects. In this connection I take the liberty to request the mem-

[1] Read before the Amer. Psych. Assoc., Washington, Dec., 1902.

bers of the association to assist in future investigation of the problem by kindly sending to me any material which they may be able to collect.

There follows now a report of the cases:

Case 1. — *Mr. W. P. M., Harvard '97*, who repeatedly succeeded with himself in these two classes of experiment which I describe *verbatim* as given by the experimenter. *Experiment I.:* "By closing my eyes somewhat tightly I could see a number of 'bits' of colored light upon my 'retinal field.' Selecting one of these colors I concentrated my attention upon it, and it seemed to grow of its own accord into a perfect circle. I then willed that this circle should become an ellipse; and without the faintest 'muscular sensations' (except the vague strained feeling of purely mental concentration) the circle 'sagged' into an ellipse; thus

Fig. 1. Fig. 2. Fig. 3.

Fig. 3 being exactly the same shape as the ellipse that I had pictured in my mind as the *ideal* end to be attained, in visible actuality upon my retinal field. This experiment has been successfully and easily performed by me a number of different times."

Experiment II. — "Fixing my attention upon one of the colored circles above mentioned I succeeded by an act of will in changing the color of the ring from blue to red. I have also changed a red ring to a yellow or green, according as I desired. There were no muscle-sensations. Having given the '*fiat*' of my will, I would wait quietly, observing the variously colored shapes float fantastically before me until the ring of the old color gave place, as it were of its own accord, to the ring of the desired color. I was not always successful in this experiment; and the length of time which I had to wait was very variable."

Case 2: *Mr. H. D., Yale Ph.D., 1896.* The tabulated results obtained by this experimenter, which are herewith presented, may be profitably supplemented by the following remarks as given in the language of the subject himself.

EXPERIMENTS ON THE VOLUNTARY CONTROL OF THE 'EIGENLICHT.'

First Series. Experimenter H. D.

No. of Experiments.	1.	2.	3.	4.
Date.	Nov. 20.	Nov. 21.	Nov. 22.	Dec. 7.
1. Time taken to produce cross.	A. M. 2–3 min. P. M. 1 min.	Same as Exp. 1.	1½ min. About 20 sec.	15 sec.
2. How long it could be retained.	A. M. 3 sec. P. M. 5 sec.	2 sec.	2 sec. 10 sec.	5 sec.
3. Modification of shape.	A. M. Several times. P. M. Bars extending.	Bars extending.	Bars extending. " "	Little change.
4. Modification of color.	A. M. Red. P. M. Red.	Red.	Deepening red. Red to whitish gray.	Silvery white to red.
5. Effect of fatigue.	A. M. Image blurred. P. M. " "	Pain back of right eye; disappearance of image.	Pain in right eye; same as to image.	Pain as before.

No. of Experiment.	5.	6.	7.	8.	9.
Date.	Dec. 8.	Dec. 9.	Dec. 18.	Dec. 19.	Dec. 20.
1. Time taken to produce cross.	A. M. P. M. 20 sec.	10 sec.	5–10 sec.	1 min. 10 sec.	20 sec.
2. How long it could be retained.	A. M. P. M. 7 sec. (clearly).	10 sec.	12 sec.	5 sec.	About 7 sec.
3. Modification of shape.	A. M. P. M. At 7 sec. it disappeared.	Cross lost in circle.	Control of shape lost.	Bars extending.	Vertigo set in and cross is lost.
4. Modification of color.	A. M. P. M. Red to deeper red.	Red to silvery gray.	Red deepening.	Bars extending.	Vertigo set in and cross is lost.
5. Effect of fatigue.	A. M. P. M. Failure of control.	Pain and then failure of control.	Deepening and vertigo.	Vertigo and obliteration.	Vertigo set in and cross is lost.

Second Series. Experimenter B. Z.

Serial Number of Experiment	I.	II.	III.	IV. *a*	IV. *b*	IV. *c*	V. *a*
Date.	Nov. 4, 1895, 7–7.15 P. M.	Nov. 5, 1895, 9–9.15 P. M.	Nov. 6, 1895, 3.45–4 P. M.	Nov. 18, 1895, 8.15–8.30 A. M.			Nov. 18, 1895, 7.15–7.45 P. M.
Eigenlicht.							
1. Color.	Golden specks on black.	Yellow broken cloud.	Light yellow clouds.	Golden on black ground.	Vivid red.	Vivid red.	Almost white.
2. Persistence.	Not steady.	Not steady.	Steady.	Steady.			Steady.
3. Shape or distribution.	Circle with outer wavy edge.	Ripples from center to edge.	Rifts of varying size.	Clouded over in streaks.	Clouded.	Clouded.	White flakes on black.
Figure.							
1. Figure desired.	Cross.	Cross.	Cross.	Cross.	Circle.	Two concentric circles.	Cross.
Figure secured.	∧	×	Cross.	Cross.	Circle.	Two concentric circles.	Cross bar.
2. Time required to produce figure.		1 m.	1 m.	Very short.		Very short.	Few seconds.
Time figure could be retained.			5 sec.		Easily retained.	Easily retained.	Few seconds.
3. Modification of shape, if any.	Second streak came later.	Second bar later and vanishing at once.	Shifting cross bar.				Cross bar shifted position.
4. Color.	Light specks.	Black.	Black.	Black.		Black.	Black.
5. Effect of fatigue.		Black spot in center changing to violet and then to green.	Effacement by bright violet color.	General blur.		Running together of colors.	Shifting colors and shapes.

Second Series.—Continued.

Serial Number of Experiment.	V.		VI.			VII.	VIII.
	b	*c*	*a*	*b*	*c*		*a*
Date.	Nov. 18, 1895, 7.15–7.45 P. M.		Nov. 19, 1895, 11.45–12.10 noon.			Nov. 21, 1895, 12.15–12.30 P. M.	Nov. 21, 1895, 7.45–7.55 P. M.
Eigenlicht.							
1. Color.	Almost white.	Almost white.	Yellow.	Red.	Red.	Diffused green; later red.	Yellow.
2. Persistence.	Steady.	Steady.	Not steady.	Not steady.	Not steady.	Steady at first.	Steady.
3. Shape or distribution.	White flakes on black.	White flakes on black.	In streaks then in clouds.			Breaking into small clouds.	Like stars on black ground.
Figure.							
1. Figure desired.	Circle.	Two concentric circles.	Cross.	Circle.	Triangle.	Cross.	Cross.
Figure secured.	Circle.	Failure.	Cross (large).	Circle.	Triangle.	Cross (small).	Cross (small).
2. Time required to produce figure.			Several minutes.	Several seconds.	Very short.	Short.	Very short.
Time figure could be retained.			Some minutes.			Considerable.	
3. Modification of shape, if any.			Small red cross took place of black one.		Second overlapping triangle.	Disappearance and reappearance of figure.	
4. Color.	Black with violet center.		Black.	Black.	First triangle black, second triangle violet.	Black.	Black (intermittent).
5. Effect of fatigue.	Black rift in center; then violet; then green.		Whole field blurred.		Everything blurred.	Dimming of color.	

Second Series.—Continued.

Serial Number of Experiment.	VIII. *b*	VIII. *c*	IX. *a*	IX. *b*	IX. *c*	X. *a*	X. *b*	X. *c*
Date.	Nov. 21, 1895, 7.45–7.55 P. M.		Nov. 24, 1895, 10–10.15 A. M.			Nov. 24, 1895, 10–10.15 P. M.		
Eigenlicht.								
1. Color.	Yellow.	Yellow.	Yellow.	Yellow.	Yellow.	Diffused white.	Diffused white.	Diffused white.
2. Persistence.	Steady.	Steady.	Steady.	Steady.	Steady.	Steady.	Steady.	Steady.
3. Shape or distribution.	Like stars on black ground.	Like stars on black ground.	Fine streaks.	Fine streaks.	Fine streaks.			
Figure.								
1. Figure desired.	Circle.	Two concentric circles.	Cross.	Concentric circles.	Triangle.	Cross.	Circle.	Two circles.
Figure secured.	Circle (large).	Series of circles not concentric.	Cross (small).	Concentric circles.	Triangle.	Cross.	Circle (large).	Number of circles.
2. Time required to produce figure.	Considerable.		An instant.	Very short.		Very short.		
Time figure could be retained.			Only an instant.			Considerable.		
3. Modification of shape, if any.								White center of large ring broke into fine rings.
4. Color.	Yellow with inner and outer bands of black.	Dim black.	Yellow not bright, soon dim.	Black and yellow alternately.	Alternately yellow and violet.	White on black ground.	Black.	White.
5. Effect of fatigue.						Figure grew gradually fainter.		Effort to produce red color in rings broke all into horizontal streaks of faint color.

1. "The color of the '*Eigenlicht*' had (*i. e.*, ordinarily on beginning the experiment) the appearance of a dancing mass of vari-colored dust, red predominating."

2. "Persistence depended upon the physical conditions, and varied accordingly. * * *" "The best results have been secured, uniformly, after a long evening's reading, where there has been continued concentration of attention. * * *" "As soon as attention and will had gained control of the mass, the color seemed to be at their mercy."

3. "The normal appearance of the 'Eigenlicht' is always round. The center of the circle is the bridge of the nose; the radius extends to the corner of the eye and sweeps over the forehead to the other eye. It seems to be very objective and quite dependent"—*i. e.*, on the will.

4. "A triangle is more easy for me to produce than a cross, and a circle easiest of all. * * *" "Generally the cross was projected, when it came, *at once*. Thus it seemed to depend upon the creation of the brain."

This experimenter has frequently testified to me that the control of the *color* of the images obtained in this way is, in his case, usually easy and nearly complete.

Case 3: *Miss B. Z., Yale Ph. D., '97.* The extended series of experiments presented herewith in tabulated form requires no separate remarks except the observation that, in this case, the control of the subject was exercised over the shape of the visual image. No evidence of marked control over its color is presented.

It is undoubtedly too early in the investigation to draw from it with confidence any extended theoretical conclusions. Certain facts of general import seem, however, to be common to all the cases which have thus far been reported; and, also, certain changes in the current theory of color vision to be at least indicated. I append, therefore, to my two reports of, in all, some fifteen cases the following somewhat tentative observations.

1. It seems obvious that the control of the size and color of the images appearing before the eyes when they are closed in the dark grows by practice. As everywhere else, so also here, trying begets habit; and ease and success accompany the

growth of habit. This was certainly so in my own case, when I first obtained the phenomena which led me to propose the problem to others. And I am inclined to think that nearly or quite all the instances of failure to get some access of successful results are due to a lack of persistence and of confidence in the possibility of finally succeeding. But here, as in the case of all our uses of the delicate and complex organic mechanism, both peripheral and central, different individuals differ greatly in their native and acquired aptitudes.

2. It is not as yet quite clear how much of the effect must be ascribed to a *selective* attention, somewhat resembling that with which we watch for, seize upon, and hold in consciousness a word which we will to recall. I am, however, entirely confident that the phenomena cannot be completely accounted for in this way. An exalted, not to say abnormal activity of the color sensations is undoubtedly favorable to obtaining the best results. In my own case, when I was excited and somewhat hyperæsthetic, my experiments were most startling as respects the success attained. Such a condition affords, as it were, an increased abundance of material upon which selective attention may be directed. Yet many of the responses made to the will appear to be almost as prompt as those which concern changes in some portion of the motor organism. Nevertheless, —

3. The testimony of all seems to be perfectly conclusive that the desired results as to the size and color of the images cannot be wholly mediated by the motor apparatus connected with vision by the eye. A certain feeling of strain, such as goes with intense attention to a visual object, is, indeed, a common accompaniment of the first efforts to obtain a circle, cross, or triangle. One is also usually conscious of focusing the eye upon this object. And pain in the eyeball, or back of it, frequently follows prolonged experimentation of this sort. *Squeezing* the eyeball with its own muscular surroundings may result in an increased liveliness of the color sensations. But unconscious and minute movements of the eye can scarcely be held to account for the appearance of the particular shape desired; and as to changes of color, I am sure I should not know how to connect any particular voluntary or involuntary

movement of the eyes with the turning at will of a red cross, or circle, or triangle, into one of green or yellow.

4. These phenomena, especially when considered in connection with numerous others — *e. g.*, certain experiments with color illusions and visual dreams, which I have previously reported to the Association, and other phenomena, which have either been simply observed or more or less thoroughly examined by different students of psychological phenomena — have convinced me that our entire modern theory of vision has gone astray in respect of the functions of nervous elements in the retina. In a word, I believe that the shapes and colors of our visual images are *centrally determined* to a far greater extent than has hitherto been supposed. In my judgment we shall never find the final physiological explanation of our experience with colors in the structure and functions of the retina. Further investigation of the histology of the rods and cones, or of the functions of the two, or of the services rendered by various pigments in conjunction with the retina, will probably not add further knowledge as to the nature or causes of the psychical phenomena. Physical and physiological or chemical theories of the retinal functions are of comparatively little value for the psychology of vision. The fusion, the differentiation, the contrast, the sequence of our color sensations, depend upon complex *cerebral* processes, the nature of which is determined, not simply by the quality and intensity of the stimuli and by the effect of the stimuli upon the peripheral organism, but also in large measure by the associations and habits of those nervous centers of the brain that are correlated with the other senses and with memory, recognition, attention and choice.

The proof that a more '*central*' theory is needed to account for our experience with visual images even of the more simple sort, their shapes and their colors, and that the influence of the retinal elements and their functions has been hitherto greatly overestimated, is by no means confined to phenomena such as I have just described. The remarkable color illusion to which I called attention in the 'Studies from the Yale Psychological Laboratory' in 1898, and color illusions in general, point in the same direction. So also do the phenomena

of 'color audition' which, if under this term we include the excitation of color sensations by auditory stimuli, are much more frequent than is ordinarily supposed. An example taken from my own experience will be of interest here. Several years ago I was having some floors in my house scraped with a metal tool in order to prepare them, by removing the old filling and wax, for being filled and waxed anew. I had several times during the noon hour amused myself by using this tool, thus establishing fusions between the sensations of sound which the tool produced and the changed and streaked colored appearance of the floor at which I was gazing intently as I worked. After this preparation of the brain, as I was lying with closed eyes on the bed in the room above, waiting for my vacation afternoon nap, the sounds of the tool used by the workman in the room below promptly and invariably stimulated in the so-called 'retinal field' the visual images of the streaks in the floor, varied nicely so as to correspond with the variations of the auditory stimuli. That is to say, when I heard the sounds of scraping, I at once saw before the eyes the same streaks which my experience had previously fused with precisely similar sounds of scraping.

It is a very common experience with me — and I find on inquiry also with others — to have the fainter or more vivid but appropriate visual images start out in the retinal field, when the eyes are closed on occasion of certain skin or muscular sensations being started; or even when, as we say, thinking vaguely and perhaps dreamily 'about' kinds of transactions that readily admit of schematic visualization. Now these are certainly forms of stimulating the production, and determining the color and shape of visual images, that have nothing whatever to do with the nervous elements or the pigments of the retina. The voluntary control of the way in which colored images shall be stereoscopically united points in the same direction. If one prepares two squares of paper of the same size, but of different colors, persistent practice to obtain control, in many cases, enables one at will, when the two squares are stereoscopically united, to see the combined image with either one of the two colors, or to fuse them in the color which is itself

the mixture of the two. Such experiences, I repeat, go a long way toward relieving us from the necessity of any further effort to find in the structure and functions of the retinal elements or in the chemical constitution of the pigments of the retina the account of color sensations, and of the phenomena of their fusion, contrast, and differentiation.

5. I shall perhaps seem to most of you to be extending unwarrantably the conclusions based upon this entire class of facts, if I say that they seem to me to bear important testimony to a certain theory of consciousness and of the nature of man's mental life and mental development. I admit at once, of course, that were these facts left standing alone the charge of gross exaggeration of their importance would be justified. But they are not alone. They are only one group of facts — of countless thousands in numbers and classifiable under a score or more of heads — which, in a way quite satisfactorily prove the truth of the general theory. Negatively stated, no theory, sensational, associational, physiological, or psycho-physical, which regards consciousness merely 'content-wise' and passively, can adequately account for even the simplest of our experiences. Positively stated, consciousness must from the very first and in all its varied forms of manifestation be considered as an active, discriminating, selective, and directive force. Only from this point of view can we explain the evolution of the so-called higher faculties of the mind. This energistic aspect of consciousness, this general faculty which is needed to account for the formation of all the particular so-called faculties of man, is everywhere present for the working psychologist to discover and to trace its historical development, in the individual and in the race. Admitting this theory, more or less of direct control over the shapes and colors of objects appearing in the so-called retinal field seems consistent enough with all that we know about both cerebral physiology and also mental life, from the psychologist's point of view, which is the standpoint of consciousness.

DISCUSSION AND REPORTS.

PROCEEDINGS OF THE ELEVENTH ANNUAL MEETING OF THE AMERICAN PSYCHOLOGICAL ASSOCIATION, WASHINGTON, D. C., DECEMBER 30 AND 31, 1902, JANUARY 1, 1903.

REPORT OF THE SECRETARY.

The eleventh annual meeting of the American Psychological Association was held in the rooms of the Columbian University, Washington, D. C., on Tuesday and Wednesday, December 30 and 31, 1902, and Thursday, January 1, 1903.

President Sanford presided and over fifty members of the Association were in attendance at the various sessions.

At the regular business meeting held on December 30, the following was transacted. Election of officers for 1903: *President*, President William L. Bryan, Indiana University; *Members of the Council to serve for three years*, Professor James R. Angell, University of Chicago, and Professor George M. Duncan, Yale University. The following new members were elected: Mr. Joseph H. Bair, Columbia University; Dr. William Churchill, Yale University; Professor S. S. Colvin, University of Illinois; Professor Arthur H. Daniels, University of Illinois; Mr. J. F. Messenger, Pratt Institute; Professor Melbourne S. Read, Colgate University; Dr. Margaret K. Smith, New Paltz, N. Y.; Dr. Helen Bradford Thompson, Mt. Holyoke College; Dr. S. F. Wrinch, Princeton University.

The Secretary reported on behalf of the Council an invitation from the American Association for the Advancement of Science to become affiliated with that association and to be represented by a delegate upon its council.

Upon recommendation by the Council the Association voted to accept the invitation and the President was appointed the delegate to the Council of the American Association.

The Council recommended that the annual dues of the Association be reduced to one dollar. After discussion, a motion to that effect was laid upon the table for one year.

On behalf of the Committee on Bibliography, the Chairman, Professor Sanford, presented the following report:

Report of the Committee on Bibliography, Washington, 1902.

The Committee on Bibliography would respectfully report as follows:

1. That after careful consideration of the questions referred to them, they would recommend that the Association undertake the compilation of a bibliography covering as fully as possible all psychological literature published prior to January 1, 1894, the beginning of the 'Psychological Index.'

2. They recommend that the Bibliographical Committee mentioned below be authorized to purchase, as the nucleus of this bibliography, so much of Professor Leuba's collection belonging to years prior to January 1, 1894, as they may deem advisable, at a rate to be mutually determined, provided, however, that the total sum shall not exceed two hundred dollars ($200), this expenditure being regarded as an equivalent to Professor Leuba for money expended for clerical work involved in making his collection.

3. That the compilation of the said bibliography be entrusted to a committee of five members of the Association (to be known as the Bibliographical Committee) endowed with full power to determine the nature of the material to be included, the method to be followed in collecting, and all other matters connected with the undertaking, except as specified in section 1 above and in the other sections of this report.

4. That no definite action be taken present with reference to publication, in view of the fact that the preparation of a complete bibliography is a matter of considerable time, perhaps several years, and that its ultimate bulk cannot be determined in advance. The present committee is convinced of the advantages of a regularly printed and published bibliography, but is not ready to recommend the Association to take action in the matter at present.

5. That the said Bibliographical Committee keep the said Bibliography, until it is judged complete, in the form of a card index, classified according to the headings at present in use in the 'Psychological Index,' and that they take such measures as they shall deem wise for making its contents from the first as useful as possible to members of the Association, in particular that they consider the feasibility of the plan contained in Exhibit A appended to this report.

6. That for the carrying out of the objects enumerated in the preceding sections they be granted the sum of three hundred dollars

($300) for clerical assistance in addition to the sum of two hundred dollars ($200) mentioned in section 2, making in all a total of five hundred dollars ($500).

7. That the said committee take such means as may seem best to enlist the coöperation of all members of the Association in the pointing out of existing lists of literature prior to 1894 and in contributing references from their own reading.

EXHIBIT A.

A Plan for Use of the Bibliography while in the Form of a Card Index.

It is suggested that the Bibliography can be made useful from the first if the Bibliographical Committee be instructed to furnish to any member of the Association applying for it a typewritten copy of such section or sections as he may desire at the actual cost of transcription (if the applicant desires to retain the transcriptions), or at one half the cost of transcribing if he returns the copy in good condition within sixty days of its receipt, the Bibliographical Committee (or its chairman) drawing upon the Treasurer of the Association for such sums as are necessary to meet the expense of the transcriptions and returning to him such sums as may be received for transcripts made, the sums drawn not being included in the five hundred dollars mentioned in the body of the report; and nothing in those provisions being so interpreted as to prevent any member of the Association from direct access to the cards of the Bibliography at such times and places as the Bibliographical Committee may specify.

It would be well also if the committee should from time to time publish in the PSYCHOLOGICAL REVIEW or *Science* statements of the periodicals covered and of the general progress of the work.

The report was adopted by the Association and the Commit ee consisting of Professors Sanford, Warren, Creighton, Sneath and MacDougall was continued as the Bibliographical Committee of the Association.

REPORT OF THE TREASURER FOR 1902.

Dr.

To balance at last meeting	$1,524.46	
Dues of members	339.00	$1,863.46

Cr.

By expenditures for		
Printing	$19.50	
Proceedings	5.19	
Postage	15.50	
Stationery	8.10	
Clerical assistance	11.27	
Expenses of Committee on Bibliography	7.27	$66.83
Balance		$1,796.63
Interest on deposits (approximate)		175.00
Total		$1,971.63

Audited by the Council.

LIVINGSTON FARRAND,
Secretary and Treasurer.

ABSTRACTS OF PAPERS.

Address of the President: *Psychology and Physics.* By E. C. SANFORD.

(The address appears in full in this number, March, of the PSYCHOLOGICAL REVIEW.)

The Psychology of Weather Influence. By EDWIN G. DEXTER.

The paper attempts to outline the more important results of a series of studies made by the writer on the influence of weather on human conduct. The method followed consisted of the comparison of the average daily occurrences of certain recorded abnormalities of conduct with definite meteorological conditions. The data, gathered principally from records kept in New York city, consisted of the daily records of suicides, of arrests for assault and battery and for drunkenness, and of the deportment of the city penitentiary and certain of the public schools; in all, nearly 500,000 separate occurrences, covering a period of ten years. The meteorological data were taken from the records of the New York Station of the United States Weather Bureau.

The studies showed that the various meteorological conditions directly affected the metabolic processes of life, some increasing the vital energy, others tending to deplete it, and that the resulting mental states were those common to conditions of excessive or depleted vitality.

Low temperatures seemed generally katabolic, with gradually increasing anabolic tendency until a mean temperature of about 85° F.

is reached, when a sudden change takes place and the effect upon available energy is disastrous. Above this point active disorder reaches its minimum, while the death rate, suicide and clerical error increase alarmingly. Low pressure is anabolic, with a reverse for a higher mercury column. A dry atmosphere is exhilarating, while a moist one is depressing. Calms were found to have a tremendous katabolic effect in New York city. For moderate movements of the atmosphere these conditions are quite reversed, while for very high winds we find them again approximated.

The clear, dry day is anabolic in its tendency, while days of an opposite character show a katabolic effect. Deportment is at its best on cloudy days, but suicide showed a peculiar anomaly, being excessive on the bright dry days.

In conclusion two facts may be mentioned:

First, children are more influenced by weather states than adults; second, women seem more sensitive to meteorological conditions than do men.

It may be added that we cannot suppose meteorological conditions to be the immediate cause of many of the abnormalities of conduct which vary with them. Suicide, for example, is more frequent when the barometer is low, yet a low barometer, we could hardly assert, drives men to self-destruction. The only thing supposable is that during such atmospheric conditions the general emotional states are of such a quality that other things are more likely to do so.

Normal Variability in Mental Traits. By EDWARD L. THORNDIKE. (Read by title.)

The Development of Memory in School Children. By JAMES E. LOUGH.

The experiments here reported were made with 682 girls, aged 9–15, in one of the New York public schools for the purpose of ascertaining the variations of memory due (1) to content, (2) to age and (3) to the 'brightness' of the children. The method of experimentation was similar to that employed by Lobsien with school-children in Kiel — lists of ten words were read to a class of children who were then asked to write down as much of the list as they could remember. The lists employed were: (I.) Ten 'color words' (red, green, etc.); (II.) ten 'sound words' (rumbling, chasing, etc.); (III.) ten numbers (28, 93, etc.); (IV.) ten 'touch words' (rough, warm, etc.); (V.) ten 'emotion words' (sad, brave, etc.);

(VI.) ten abstract words (result, direction, etc.); (VII.) ten concrete words (Japan, Dewey, etc.); (VIII.) a second list of numbers. Color words were best remembered (av. 86 per cent.), then followed in order, concrete words (av. 75 per cent.), touch words (av. 70 per cent.), emotion words (av. 68 per cent.), sound words (av. 58 per cent.), abstract words (av. 50 per cent.) and finally numbers (av. 45.5 per cent. for the first list and 44.5 per cent. for the second list). This order was constant save at the age of 9 when emotion words changed from fourth to second place. There was surprisingly little improvement of memory between the ages 9 and 15, the average change being about 5 per cent., the maximum coming at 13 with the single but marked exception of emotion words which reach a minimum at this age. Memory for concrete words shows the greatest improvement (13 per cent.) and memory for numbers the least. In the earlier years the 'brighter' pupils show better memories than duller pupils in corresponding grades, while in the later years the duller pupils show a marked superiority of memory.

Early Music Interests of the Child. By WILL S. MONROE.

The music interests of 161 children between the ages of three and six inclusive were tested along the following lines: (1) Ability to learn the scale; (2) ability to remember the scale; (3) ability to remember simple songs; (4) fondness for music. Ability to learn the scale was least at three years and greatest at six: 29 per cent. of the boys and 47 per cent. of the girls at three, 31 per cent. of the boys and 54 per cent. of the girls at four, 34 per cent. of the boys and 59 per cent. of the girls at five, and 40 per cent. of the boys and 71 per cent. of the girls were able to learn to sing the scale. The girls throughout surpassed the boys in ability to sing the scale.

Ability to remember the scale a fortnight after it had been taught — with several intervening reviews — was represented by 19 per cent. of the boys and 23 per cent. of the girls at three, 27 per cent. of the boys and 33 per cent. of the girls at four, 29 per cent. of the boys and 45 per cent. of the girls at five, and 40 per cent. of the boys and 57 per cent. of the girls at six. The girls surpass the boys in tone memories, although sex differences are less pronounced than in ability to learn the scale.

Ability to learn and remember songs was much greater than ability to learn and remember the scale. At the age of three, 43 per cent. of the boys and 59 per cent. of the girls; at four, 50 per cent. of the boys and 61 per cent. of the girls; at five, 47 per cent. of the boys

and 62 per cent. of the girls; and at six, 60 per cent. of the boys and 71 per cent. of the girls remember for a fortnight the songs that have been taught them.

Fondness for music furnishes necessarily vaguer returns, yet the results are suggestive. At three, 33 per cent. of the boys and 53 per cent. of the girls; at four, 31 per cent. of the boys and 60 per cent. of the girls; at five, 23 per cent. of the boys and 65 per cent. of the girls; and at six, 20 per cent. of the boys and 57 per cent. of the girls are reported fond of music.

Experimental Psychology and the Elementary School Curriculum. By FRANCIS BURKE BRANDT.

The purpose of the paper was to direct attention to the elementary school curriculum as a field for psychological research by offering a report regarding some tentative experiments being carried on in the experimental school established in connection with the Philadelphia School of Pedagogy. The experiments have aimed at the solution of three problems: (1) In the daily time programme, what subjects shall be included as qualitatively coördinate? (2) shall the subjects regarded as qualitatively coördinate be treated as quantitatively coördinate? (3) shall the qualitatively coördinate subjects succeed each other in the daily school programme in any specified order? Several thousand observations have been made on boys while they were engaged in the several school studies, with a view to determining the typical modes of activity characteristic of each school subject. These observations show that the activities involved in all of the heterogeneous and multiform 'subjects' constituting the elementary school curriculum are reducible to five fundamental and clearly differentiated forms, describable as reflectional, observational, conversational, ideational and creational. Repeated study of the typical postures and positions of a class shows that, generally speaking, the emphatic character of mathematical activity is reflectional, that of natural science observational, that of history conversational, that of language (linguistics and literature) ideational, and that of school arts (music, drawing, manual training) creational. Otherwise stated, mathematics exercises brain attention; natural science, eye attention; history, ear attention; language, especially the reading of literature, ear and eye attention; school arts, external expressive activity — the rendering of the inner outer.

Conceiving the curriculum as a highly specialized mode of daily experience and as consisting of the subjects above enumerated as quali-

tatively coördinate, the second part of our experiment has been to formulate and put to experimental test a school programme in which an equal amount of time is assigned daily to each of the coördinate subjects. Incidentally we are also testing a specified order in which the qualitatively coördinate subjects are made to succeed each other in the daily programme. This programme follows:

A Grammar School Daily Programme.

Closing Time.	Minutes.	Subjects.	Groups.
9:10	10	Opening exercises.	
10:00	50	Arithmetic.	I. *Mathematics.*
10:25	25	Physiology.	II. *Natural Science.*
10:45	20	Recess.	
11:10	25	Geography.	
12:00	50	History.	III. *History.*

NOON INTERMISSION.

Closing Time.	Minutes.	Subjects.	Groups.
1:35	5	Opening exercises.	
2:00	25	Grammar (spelling, etymology, syntax, composition).	IV. *Language.*
2:25	25	Literature (reading).	
2:40	15	Recess.	
2:52	12	Music.	V. *Arts.*
3:30	38	Drawing, penmanship, manual training.	

Summed up, this programme has been under experimental test for three years. It is an attempt to demonstrate experimentally: (1) That the qualitatively coördinate scholastic subjects suitable for elementary instruction may be adequately and best conceived under five fundamental forms whose appropriateness as subject-matter for instruction is determined in each case primarily by its value as a daily mode of experience adapted and suitable to the psychological nature of the child; (2) that inequitable distribution of time to any one of these five fundamental forms means over- or under-activity of some fundamental side of the child's nature; and (3) that by a specified order of taking up the several subjects daily, the health of the child is properly safeguarded through a rational alternation in the exercise of different kinds of attention.

An Experiment with the Questionnaire. By H. Austin Aikins.

Ten thousand children in the first eight grades of the Cleveland public schools were asked, 'What is the worst thing you ever saw

anybody do?' and 'What is the best thing you ever saw anybody do?' This is a preliminary report on the answers to the first question.

There are several well-marked curves, showing changes in the children's moral interests. As we go up the grades the curves for bad language, stealing and cheating, smoking and chewing, disobedient and disorderly conduct, fall. Those for cruelty, unkindness and mean acts rise. In the higher grades cruelty is mentioned far oftener than anything else.

Analysis of the cruelty answers gives remarkable curves for cruelty to birds and to horses. Birds are mentioned in the first grade about as often as all other animals put together, and in the eighth hardly at all. With horses this is reversed.

So far as there is any difference between the two, boys tend to name masculine vices, and girls feminine. Some of the curves seem to indicate that boys get new ideas or interests about a grade earlier than girls.

The Position of Psychology in the System of Knowledge. By HUGO MÜNSTERBERG.

(The paper appears in full in *Harvard Psychological Studies*, Vol. I., 1903, PSYCHOL. REV., Mon. Sup., No. 17.)

Psychological Method in Ethics. By JOHN DEWEY.

It is commonly agreed that the most generic distinction between philosophy and the sciences is that the former deals primarily with values, and the latter with facts or presented phenomena. Or, in rough but convenient phraseology, the philosophic disciplines are normative, the scientific descriptive. From this general premise it is argued that since psychology is a science concerned with facts and events (states of consciousness, and their physiological correlations), it can have no essential bearing upon ethics, a branch of philosophy concerned with a particular sphere of value. I wish to point out that one may accept both the generic distinction referred to and the placing of psychology as a purely natural science, and yet maintain that psychology furnishes an indispensable phase of method in ethics.

1. While affairs of conduct are primarily matters of value, viz., functions and attitudes, not of mere presentations in the stream of conscious states, and hence not a part of direct psychological data, it yet remains true that every such conduct-value has its signature or correspondent in the body of immediate data or presentations. That is to say, an end or ideal of behavior is not to be sought for as a mere psy-

chological presentation; but since it marks a positive distinction within conscious experience there must be a conscious state which somehow corresponds to it, and, for the psychologist's purpose, *carries* it.

2. The psychologist can study the particular conditions in the stream of presentations of that particular content which represents the having of a moral ideal; and he can trace the influence, in the way of stimulation and inhibition, which such content exercises upon further presentations in the stream. Psychology as genetic is concerned precisely with just such problems of origin and subsequent career; the matter of further career being a strict part of genetic psychology in so far as any one presentation is found to furnish specific conditions.

3. It is practically impossible to see how any control of the interpretation of the meaning to be justly assigned to the category of, say, 'ideal' is to be secured without recourse to just such a device as this. Just because the ideal in actual moral experience is a matter of immediate personal worth, it is unanalyzed. Just because the presentation is not the moral reality, but gives it in an abstract and detached form, it renders the ideal capable of objective analysis and statement, or lends itself to the needs of intellectual control. Normative philosophy is not concerned with a mere reproduction of the original, vital experience. To object to the employment of psychology because it does not constitute or present the value with which it is concerned, would, therefore, so far as its logic is concerned, rule out any philosophic interpretation whatsoever. The only way to have the value is to have it as a matter of personal experience, and that is no more philosophy than it is science. To say then that psychology cannot give the ideal is entirely aside from the point. Philosophy cannot 'give' it either. What psychology can do is to study in a definite and analytic way the meaning of a value as determined by its origin and function in the stream of experience.

4. It is clear that the use of psychology in this way is formal rather than material. That is to say, it does not tell what the concrete ethical ideal is; it tells what any experience must be if it is to be qualified as ideal. It shows the conditions of origin and use to which any qualitative experience must conform if it can be properly characterized as aim, end or purpose. It is quite clear, however, that such determination is not *merely* formal. The very fact that there are certain specific conditions of origin and career to which the candidate for ideal value must submit itself, gives a definite intellectual base line from which to measure the claims of such a candidate. In other words, if it is said that pleasure of perfection and self-realization, or

recognition of duty, is the ideal, we have at once a definite method to pursue. Can they fulfil the conditions of origin and functioning which are demanded? Or, putting the matter more positively, the knowledge of these circumstances of genesis and subsequent career, enable us to delineate the main features of anything which has legitimate claim to be considered as end or ideal. If we assume for the moment that an anticipatory image is the psychological counterpart of the moral ideal, our problem is defined as the discovery of the adequate stimulus and the adequate use of functioning of such an image in experience. Such an analysis carried to its end would certainly leave us with a very positive notion regarding the generic traits of the ethical ideal. The form thus determined is not a form separate from all matter of experience, but is the form or framework of a certain kind of actual experience.

Critique of 'Psycho-physical Parallelism.' By GEORGE TRUMBULL LADD.

In opposition to all forms of the current hypothesis of so-called 'psycho-physical parallelism,' the paper made the following points: (1) All the data for any theory as to the relations of body and mind originate within the unity of the 'stream of consciousness.' The connections between the different items or 'moments' of this stream are not merely those of sequence in time; but they also have the appearance of dynamical connections. (2) Just as apparent as the fact of this unity is the fact of a certain *diremption* accomplished by the activity of discriminating consciousness. Some of the psychoses are ascribed to the *Ego* as their subject, and others are more definitely localized in the organism. (3) These two classes of experiences are now inevitably regarded by the natural 'ontological consciousness' in terms of the interaction of body and mind. (4) So true and inevitable is all this that the very conceptions 'cause,' 'causal relations,' 'causal influence,' etc., originate and receive their chief validation from this experience; and without it, no question as to a theory of the relations in reality of body and mind could ever arise. (5) Judged from the point of view of experience the figure of speech involved in the term 'psycho-physical parallelism' is both inadequate and misleading; it is inadequate, because it utterly fails to emphasize the complicated net-work of interrelations of which we have an indubitable experience; and it is misleading, because it neglects the *dynamical* character of the interrelations. (6) These defects are emphasized anew, when the theory becomes metaphysical and strives to state itself in terms of the 'ontological consciousness.' (7) For purposes of

psychological science it is the business of the investigator, assuming the standpoint of the natural dualistic hypothesis, to discover the precise nature and empirical formulæ of the interrelations. But, finally, (8) philosophy is not satisfied to leave the subject in this shape; it seeks a '*uniting bond*' for these, and for all other dynamical connections of our experience. This bond it must find in the Being of the Cosmos, whose being man, with the totality of his nature, shares.

The Theory of Energetics in its Philosophical Bearings. By JOHN GRIER HIBBEN.

The claims of the *Energetiker* as expressed by Ostwald in his lectures on *Naturphilosophie* delivered at Leipzig, in the summer of 1901, may be briefly summarized as follows:

The most universal concept employed in scientific circles to-day is that of energy. All other concepts can be derived from it. Energy can be defined in terms of work, as that which is the result of work, or that which may be transformed into work. Thus the metaphysical concept of substance, and of cause may be expressed in terms of energy. Matter may be expressed in terms of form-energy and volume-energy. Matter, therefore, gives way to energy, and with the passing of matter, the transition from physical to psychical phenomena becomes immensely simplified, for it is possible to conceive of a psychical energy as transformed physical energy more readily than we can coördinate matter and mind. The general position is fortified by three analogies:

1. As a transition is effected from physical to nervous energy, so also a like transition occurs between nervous and psychical energy. It is no more difficult to conceive the one than the other.

2. As only a few crystals under pressure manifest electrical phenomena, so not all energy is accompanied by consciousness but only in the unique case of the central energy of the brain. This relieves the necessity of correlating consciousness with all forms of energy.

3. As a storage battery produces energy out of all proportion to the liberating cause, so also the centrally stored energy produces results out of all proportion to the nervous energy which acts as its liberating cause.

In criticising this theory the following theses were discussed.

1. Its mathematical presuppositions and processes are precariously uncertain, as indicated by Boltzmann and Planck.[1]

[1] See *Annalen der Physik und Chemie*, N. F., B. 57, S. 39, 72.

2. The mechanical or dynamical expression of any physical system does not purport to give an exposition of the essential reality of the phenomena which it describes.

3. The correlation of the various forms of physical energy expresses a quantitative equivalence. But the attempted correlation of nervous and psychical energy is distinctively qualitative.

4. The definition of energy in terms of $\frac{1}{2}mv^2$ represents its essence under space and time conditions. But mental phenomena cannot be brought under such categories.

5. Psychical energy is either the same in kind as nervous energy or it is not.

If it is, it must be a disguised form of mass and velocity relations.

If it is not, it lies outside the initial concept of energy altogether.

6. If we compare the physical world as a whole with the world of thought as a whole, we find the former characterized by a decrease of energy and an increase of entropy. The reverse is true, however, of the world of thought.

7. The concept of energy is not a 'form' of the mind in a Kantian sense, as Ostwald maintains.

8. Ostwald affirms that 'the continuity of experiences in one brain or in one mind' constitutes the consciousness of personal identity.

If this continuity, however, is maintained by the brain regarded as an organ of physical energy, it fails to account for the resulting continuity of consciousness.

If, on the other hand, it is maintained by the subjective thought center, this transcends the fundamental concept of energy.

The Status of the Subconscious. By JOSEPH JASTROW.

The speaker presented a survey of the field of the subconscious emphasizing the position which this topic should occupy in the framework of psychology. The subconscious represents the great other half of the mental processes coördinate in theoretical importance if not in practical effect with the conscious processes. The subconscious participates in every one of the factors that together constitute the onward movement of the mind, and is to be understood through its normal manifestations in every-day thinking. Those topics that contribute more especially to the field of the subconscious are: (1) The distribution of consciousness in ordinary occupations; (2) the phenomena of distraction; (3) dreams; (4) special control over the subconscious as in crystal gazing; (5) automatisms; (6) efforts to retrace trains

of thought. On the abnormal side the field includes trance states, the action of drugs, more pronounced automatisms, disorders of personality. The tendency to form a conception of the subconscious too exclusively on the basis of the abnormal was opposed and the importance of the consideration of normal and commonplace characters for the elucidation of the status of the subconscious in psychology was emphasized.

The Apparent Form of the Heavens and the Illusory Enlargement of Heavenly Bodies at the Horizon. By A. H. PIERCE.

1. To assist in determining whether the illusion of the horizontal moon depends upon the apparent form of the heavens, questions were sent out relative to the apparent form of the sky by day and by night, and also to the apparent size and distance of the moon at horizon and zenith. One hundred replies were tabulated. (*a*) In clear weather by day 31 see the dome of the sky flattened, 31 see it hemispherical, 36 see it raised. Two did not reply. In cloudy weather by day the figures are respectively 79, 10 and 7. Seven did not reply. In clear weather by night 24 see the heavens flattened, 18 see them hemispherical, 48 see them elevated. Ten did not reply. There is thus a fair tendency to see the heavens in the form of an elevated dome by night. Forty-eight see the heavens in the same form both by day and night, in clear weather, 14 seeing them flattened, 10 hemispherical and 24 elevated. (*b*) As to the moon, all see it larger at the horizon, of course. For 89 the moon seems more distant at the zenith, for 9 only more distant at the horizon. Two did not reply. The illusion of the horizontal moon and the apparent form of the heavens seem thus to be unconnected matters. This is further shown by the fact that to 75 the moon seems to float. This fact helps to explain certain disparities between perceived form of sky and apparent distance of moon. Three see the heavens raised at night, yet the moon seems more distant at the horizon. Twenty see the heavens flat at night, yet the moon seems more distant at the zenith. Nineteen see the heavens hemispherical at night, yet sixteen see the moon more distant at the zenith and three more distant at the horizon.

2. A comparison of illuminated disks, after the manner of Bourdon, contradicts the results of the latter and shows that at angles of elevation of 0°, 22½°, 45° and 90° equally appearing circles correspond to visual angles in the ratio respectively of 1, 1.4, 1.6 and 3 The raising of the gaze appears therefore to be influential in diminishing the apparent size of objects seen thus.

3. Preliminary determinations seem to show that the moon illusion ceases at about 30° of elevation. Consequently, the cause of the illusion is hardly to be sought for entirely in the direction of the gaze.

Direct Control of the Retinal Field. By GEORGE TRUMBULL LADD.

In addition to the cases reported in the PSYCHOLOGICAL REVIEW for July, 1894, the paper reported three cases of subjects who were able to acquire a marked control over the shape and color of the sensations arising in the so-called 'retinal field,' with the eyes closed and apparently motionless.

On the basis of all these cases, some fifteen in number, the following conclusions seemed warranted:

1. The control of the size and the color of the images appearing projected before the eyes, when they are closed and in the dark, increases with the repeated effort at control. Here, as elsewhere, control grows by practice.

2. A part, but not all of this control, seems to be due to the well-known effects of selective attention. In certain cases, however, the desired change of color seems to follow the conative impulse almost as promptly as do the movements effected by the voluntary muscles.

3. Although certain muscular effects are undoubtedly connected with the strain of attention and the location of the visual image, the shape and especially the color of this image do not appear to be dependent upon the volition *through* the motor organism.

4. These phenomena, when taken in connection with numerous other allied phenomena, indicate the necessity for a more *central* theory of visual sensations. The shape and the color of these visual images are *not* dependent upon the character of the peripheral excitation. Probably the functions of the rods and cones, and of the pigments of the retina have much less to do than has hitherto been supposed with the character of the visual images.

5. In a tentative way we may say that these phenomena favor the dynamical theory of conscious mental life, rather than the theory which emphasizes passively received content.

The Effect of Screens on Acuteness of Vision. By CHRISTINE LADD FRANKLIN.

This paper gave the result of an investigation carried out last summer at the University of Berlin, and already briefly reported on by Professor Nagel in the Proceedings of the *Physiologische Gesellschaft.*

It has been noticed that screens, when held near the eye of the observer or near the object looked at, interfere very little with clearness of vision. On the one hand, veils as worn by women (as Professor Nagel has said) are of very slight inconvenience or they would be discarded. On the other hand, a tarlatan screen stretched across the stage in front of *tableaux vivants*, while it softens the outlines a little, is absolutely not perceived as an obstruction. But there are intermediate points at which the disturbance is much more serious. It was to study the law of these disturbances that the investigation was undertaken. The more detailed results will appear later in the *Zeitschrift für Psychologie u. Physiologie d. Sinnesorgane.*

The Supplementary Image in Recognition. By ELEANOR A. MCC. GAMBLE and MARY WHITON CALKINS.

This paper reported the repetition and modification of an experiment performed by A. Lehmann and described by him in the *Philosophische Studien*, Vol. VII. The experiment consisted simply in giving to subjects who were not aware of the point at issue a series of odors and in requiring them (1) to write down, *in order if possible*, whatever the smell brought to mind; (2) to note with a dash each pause in the flow of ideas; (3) to mark the smell as 'familiar' or 'unfamiliar'; and (4) to underscore the name-image if it was suggested.

The main result of the investigation is a negative one. Lehmann's theory of recognition as constituted by the occurrence of supplementary images is disproved by the following facts: (1) Not only recognition but the consciousness of unfamiliarity is often accompanied by supplementary associations clearly due to the quality of the unfamiliar odor. (2) In cases in which the time-order is noted, the supplementary imagery is most commonly recorded as distinctly subsequent to the recognition. (3) Imagery clear enough to be remembered does not always occur in cases in which recognition is well marked. The paper will appear in full in the *Zeitschrift für Psychologie u. Physiologie d. Sinnesorgane.*

The Orientation of Certain Tactual Perceptions. By WILLIAM CHURCHILL.

Weber (cf. *Sitzgsber. d. k. Sächs. Gesellsch. d. Wiss. Math.-phys. Cl.*, 1854, S. 85) once observed that forms such as letters traced upon the skin are variously oriented upon different parts of the body. Although he recorded only one mode of orientation upon each area mentioned, a recent investigation covering thirty-eight observers (including eight blind) has shown marked individual differences.

Considering the experimenter's view-point as the norm and using the same figure in different positions to indicate the amount of divergence exhibited, it may be said that (1) upon *forehead, cheeks and chin* two distinct types of observers were found, one whose mode of orientation agreed with that of the experimenter (L being perceived as L), and a second, much more frequent, which perceived the letters in a way analogous to 'mirror-writing' (L as ⅃); (2) upon the *breast, abdomen and ventral side of the lower limbs*, in addition to the types just mentioned, a third type was noticed (L as ⅂); (3) upon the *dorsal side*, with the exception of a few instances of curious inversion (L as Γ), all observers coincided with the experimenter in orientation. Visual influence was excluded so far as possible by requiring the observer to render his decision with closed eyes. Of the eight blind observers (six congenital cases) only the two with a record of vision in early childhood exhibited a tendency toward the third type.

The number of normal observers who indicated a decided preference for any one type upon the respective surfaces is set down in the following table. Any observer not giving at least seven out of ten answers in accordance with the same mode of orientation was classed as indefinite.

Surface Stimulated.	Type. I. L	II. ⅃	Γ	III. ⅂	Not definite
Forehead	*2*	*28*			
Cheek, right	13	14			3
Cheek, left	3	24			3
Chin	3	27			
Breast	*3*	*13*		*10*	*4*
Abdomen	*2*	*8*		*12*	*8*
Thigh, right, ventral side	3	10		9	8
Thigh, left, ventral side	4	11		8	7
Shin, right	3	13		7	7
Shin, left	3	11		6	10
Occiput	*30*				
Back	*30*				
Thigh, right, dorsal side	24		2		4
Thigh, left, dorsal side	24		2		4
Calf, right	27		3		
Calf, left	27		2		1

Repetition of the experiments upon fifteen observers proved that the preferences exhibited upon the first occasion were in most cases persistent.

As explanation it is suggested that Type I. indicates a predominance of revived muscular sensations (particularly because so often

found upon the *right* cheek in close proximity to the hand customarily used in writing) in Type II. the tactual impressions are related directly to the 'absolute space' of the body; in Type III. visual memories are conspicuously active. Introspection by the observers gave confirmatory testimony.

Perhaps a test of orientation may be of service in distinguishing between the so-called motor type and the strong visualizer.

The Factors of Affective Tone in Simple Rhythm Forms. By ROBERT MACDOUGALL.

(The paper appears in full in the preceding number (January) of the PSYCHOLOGICAL REVIEW.)

Researches on the Voice. By E. W. SCRIPTURE.

Ten Years of American Psychology: 1892–1902. By EDWARD FRANKLIN BUCHNER. (Read by title.)

In the effort modestly to mark the first decennium of the life and work of the American Psychological Association, the paper sketched the features of the earlier American psychology and reviewed the progress made in the establishment of laboratories and the appearance of systematic literature during the ten years preceding the organization of the Association. Special analysis was made of the work accomplished inside the Association from its beginning, with which was contrasted the chief psychological achievements outside the Association. Various suggestions, including that of the establishment of a prize gold medal in psychology, were made with a view to improving the condition of the science in America. The Association has received 283 papers, reports, etc., topically distributed as follows: general (56), sensation (53), genetic, social and individual (41), higher manifestations of mind (39), cognition (34), conation and movement (17), characters of consciousness (13), mental tests (11), sleep, trance and pathology (10), anatomy and physiology of the nervous system (7), and affection (2). Another distribution of this material shows the work of the Association to have been thus: experimental (86), philosophical (34), apparatus (28), theoretical (25), genetic (25), descriptive (23), physical and physiological (20), historical (12), pedagogical (12), comparative (7), miscellaneous (7), discussions (4). Of the 148 members elected during the decennium, 89 have contributed to the activity in the annual meetings, the average attendance at the annual meetings has been almost 35; the average number annually elected to membership is almost 12;

the average number of contributing members is only about 20. The increased scientific sociability of psychology during the ten years was reviewed. The growth of psychology, as indicated by the widespread establishment of laboratories and the rapid multiplication of means for the publication of research reports, and a descriptive account of the chief events and emphatic features year by year concluded the scope of the paper.

A New Field for Psychologists. By JOHN P. HYLAN.

Experimental psychology is the ruling phase of our science at the present time. The recency of this phase has prevented the experimental method from being applied in a comprehensive way to the whole of the subject. As a result psychology has not been developed to meet the needs of every-day life, and has also suffered from the lack of a consistent purpose. The sciences in which we excel have been developed in response to practical needs. May not psychology similarly profit by being given a practical aim?

As a suggestion towards this end may be mentioned the need of a psychology of the moral life. The lack of an adequate method of moral education is shown the most forcibly by the prevalence of crime. A conservative estimate of the annual cost of crime in the state of Massachusetts is $5,151,130, or a cost per capita of $1.84, being two thirds the average cost of education for every person in the United States. In addition to this direct cost to the taxpayers, must be added the support of families deprived of their maintenance through the retention of wage earners in prison, and the loss and destruction of property caused by law-breakers. It is thus to one of practical interests as well as to the philanthropist and scientist that the need of a science of moral culture appeals.

This, however, is not a new field in the sense of not having gained the attention of psychologists before. Several of our leading contemporaries have shown interest in the problem. What we need is the development of practical methods for the prevention of crime, and the regeneration of the criminal type of character when once formed. As a means to this end, individual criminals should be made objects of minute study, and the conditions which attended each step in crime carefully scrutinized. The effects of monotonous work, of fatigue, of amusements, diet, and social influences should receive exhaustive study, and also localities which are especially productive of the criminal character. To this end every house of detention should have a resident psychologist who should command every facility for furthering this

study. Charity organizations, university settlements, and school boards should employ expert psychological assistance in detecting criminal influences among certain classes and society at large.

The advantages of such an application of psychology would not lie wholly in the sphere of moral culture, for in this way mental science would gain some of the organization and native completeness that has been sacrificed through the method of analysis.

The Golden Section as an Æsthetic Canon. By WILLIAM A. HAMMOND. (Read by title.)

On the Psychology of a Group of Christian Mystics. By JAMES H. LEUBA.

I. *The Tendencies.*

The extreme sensitiveness of the Christian Mystics to certain organic processes brings with it a deepening of four needs or tendencies. They are (1) the need of mental peace; (2) the need of an affective support; (3) the tendency to organic enjoyment; (4) the tendency to the universalization of action.

Concerning the tendency to organic enjoyment.

If our Christian Mystics usually refuse their body the ordinary satisfaction it craves, it is not because of the unholiness of the pleasure itself, but because sexual passion, even when within legitimate bounds, places one so frequently and, often, so irresistibly, in opposition to the finer moral promptings. But the yearning for organic enjoyment is too strong and in itself too innocent to permit of the sudden elimination of that part of our nature. The Mystics have found a way of gratifying, to some extent at least, the sexual cravings and at the same time of avoiding the moral dangers lurking in the ordinary way of giving them satisfaction. This conciliatory course is erotomania with the idea of Jesus, the Virgin Mary, or God as respondent.

As the enjoyment they secure in this way does not come from practices guilty in their eyes, but, on the contrary, from the vivid realization of the surpassingly great love to them of an absolutely good God, its effect is elevating rather than debasing; it becomes a strengthener of holy resolves; it cements together the tendencies according to the 'will of God' and increases their power.

Concerning the tendency to the universalization of action.

Deep significance is to be attached to the heroism of the unremitting efforts of our Mystics in favor of universalized conduct, *i. e.*, of action proceeding from generalized motives. Their own habit is to designate such conduct as the performance of God's will. What is

peculiar to them is that the highest good they recognize has at its service a psycho-physiological imperative mechanism; the 'ought' is backed in them by a compelling motor force.

II. *The Mystical Ecstasy.*

When we want ineffective desires to triumph there is no more powerful means at the command of science than to induce hypnosis and then to suggest the wished-for victory. Now, the Mystics have developed in their endeavor to satisfy their needs a method of worship which places them (while under the control of the God-idea) in a condition of increased suggestibility. This method they call *Orison*. It is, in its lower degree, a meditation upon God and, in its higher, a trance looked upon as union with Him. In the progress of the soul to God the two great periods observed in hypnosis are clearly marked: (1) loss of muscular control, (2) loss of sensory perceptions. It differs from the ordinarily induced hypnosis in that it is dominated by a feeling of love. The mystical ecstasy is then a love trance, more or less profound, in which the idea of God, or of Jesus, or of the Virgin, takes the place of the hypnotizer. What is to be chiefly noticed is that this so-called 'higher' religious exercise of the Mystics gives them at once mental peace, a vivid feeling of the presence of the Great Comforter, the delights of passionate love and, moreover, brings with it a strengthening of all the tendencies that are believed to be in accordance with God's will.

One may generalize and say that in all religions the attitude looked upon as most divine is one of increased suggestibility. The most general and the most significant statement which the psychologist can make regarding the religious attitude *par excellence* is that, among all peoples and at every degree of their development, it is a trance dominated by tendential ideas, not everywhere the same, but expressing always the needs accounted highest by the individual or by the society to which he belongs.

(See the *Revue Philosophique* for July and October, 1902.)

Researches on Methods of Memorizing. By C. N. McAllister. (Read by title.)

Apparatus for Producing and for Recording Serial Stimuli. By James Burt Miner.

Attention was called to the fact that at least a dozen researches on rhythm and time had been carried on in this country alone within the least three years. The investigation of problems of this nature makes

desirable a simple instrument for giving electric contacts in series. An inexpensive contact wheel to be rotated by a motor and speed reducer was exhibited. The instrument, when thus connected, gave a half-second interval with an average error of only five sigma in ten reproductions. The length of the interval could be changed by moving the pins mounted on the rim of the wheel. These pins could be easily and exactly adjusted and thrown into or out of operation. The electric circuit was made without the current passing through the wheel. This was done by means of a special contact, consisting of two parallel flat springs attached to the base, and so arranged that the pins on the wheel, as they passed, just touched the nearest spring. The electric circuit was made by the crossing of two lines of platinum, attached to the adjacent surfaces of the springs.

A new recording apparatus was described which utilizes the carbon ribbon of a typewriter in making a record of successive movements. This 'carbon-ribbon kymograph' has been used for registering with electric pens on the common telegraph-ticker tape a time line of seconds and the subject's reproduction of the interval for an hour without interruption. A form of glass pen attached to a tambour was also shown, to be used for writing with ink by capillary attraction. Curves of the blood pressure and pulse had been satisfactorily traced with it. An improved form of a continuously adding finger dynamometer was presented. The instrument weighed only three ounces and was especially convenient for making fatigue tests on school children. The above pieces of apparatus had been developed or improved at the Columbia laboratory under the direction of Professor J. McK. Cattell and used by Mr. Miner in connection with his study of rhythms.

Description of New Apparatus. By E. B. DELABARRE.

1. *A Continuous Roll-paper Smoke Recorder.*— A roll of paper is placed in a smoking-box, underneath the recording table. A ventilating tube, leading into a chimney, prevents escape of smoke. The wick of an oil-stove is raised and lowered automatically, as the apparatus starts or stops. Between the flame and the recording-paper is interposed a continuous band of wire mesh. This moves across and around under the box, passes over a brush to prevent clogging, and effectually prevents scorching of the paper. The paper is led from the smoke-box across the top surface of the table, where records are made. A long weighted cord draws the slack of the paper up across the room, after it emerges from the driving apparatus. Without an assistant, a six-inch record has been made of pulse and respi-

ration curves for a half-hour continuously, before it was necessary to interrupt the process for cutting-off the used paper. With an assistant, the apparatus can be used without interruption as long as desired.

2. *A Cylinder Chronograph.*— A synchronous motor will reproduce in the laboratory the approximate uniformity of revolution belonging to the generating apparatus of an electric lighting station. A cylinder connected with the motor can be used for time-records, with the advantage that the length of line recorded is directly proportional to the time interval measured, and hence the latter can be read off rapidly. A quickly applied correction is then necessary to offset actual variations in speed, as determined by a speed-recorder. Measurements by a tuning-fork show that by this method a very high degree of accuracy is attainable. Records are made either directly or electrically, and either on the cylinder itself or on paper covering it. The cylinder is sufficiently wide to accommodate a long series of records, and is fitted with automatic devices for giving and recording signals, and for readjustment after each record.

3. *An Inexpensive Pendulum Chronoscope.*— A weighted cord swings across a scale divided into Σ intervals; and behind a strip of wood that can be pressed firmly against a cord, interrupting the motion of its upper part but leaving the lower part free to swing on without strain. Visual signals are given by the uncovering of a window in a screen, twenty or thirty Σ after the beginning of the swing. The apparatus involves a certain degree of inaccuracy, but will give all the accuracy needed for a large number of more common purposes.

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Members will please notify the Secretary of any errors in names or addresses as given in the above list.

WESTERN BRANCH OF THE AMERICAN PSYCHOLOGICAL ASSOCIATION.

The Western Branch of the Psychological Association held its first regular meeting at the University of Chicago on December 5 and 6, 1902. Eight institutions were represented at the session. The program contained papers by Professor Coe of Northwestern University, Dr. Fite of the University of Chicago, Professor Gale of the University of Minnesota, Professor Angell of the University of Chicago, and Professor Jastrow of the University of Wisconsin. The comment and discussion stimulated by the papers was vigorous and suggestive.

The next meeting of the Branch will be held at Northwestern University.

The Executive Committee, consisting of Messrs. Dexter, Coe and Angell, was reëlected, Professor Coe being appointed chairman vice Professor Angell.

AN EXAMPLE OF AN ASSOCIATION THROUGH A FORGOTTEN IDEA.

At the request of Professor Scripture I have written out the following account of a mediate association.

I was sitting in my college room, studying or writing, one afternoon, when I heard for the first time the chimes which had lately been presented to the college and located in the chapel tower. My attention was naturally arrested from the work which I was doing, but instead of my mind dwelling upon the novelty of the chimes or returning to the broken thread of my work, there suddenly flashed into my mind a scene which I could not locate. The picture was that of a red brick building, situated upon a hill, and associated with the picture was the thought of myself as being in a novel, unfamiliar relation to it. The circumstance interested me, and I thought enough about it at the time to make a record of it, and to try to place the scene. On going home and describing the circumstance to my mother, she reminded me that my description corresponded to the location of a large school in a place where I had spent a week visiting when I was ten years old, that is, ten years before the incident. The sound of the college chimes was much the same as the sound of the chimes at the school building, but I did not know or had entirely forgotten that I had ever heard them. But the scene which they recalled was sufficient to enable my mother to identify it with its actuality.

M. E. Alling.

Yale University.

PSYCHOLOGICAL LITERATURE.

Psychologie Économique. G. TARDE. Paris, Alcan. 1902. 2 vols. Pp. 383 and 449.

The title 'Economic Psychology' suggests fields of thought highly interesting to the social psychologist. For recent economic theory, through its studies of value, or by the path of the 'historical method,' has given increasing recognition to the psychological forces at work in the economic field. In the opening chapters of his work, Tarde makes a forcible presentation of the psychological factors which enter into economic problems. The psychology which has been taken into account has been too largely individual psychology. The influence of men upon each other — the field of *inter-psychologie*, as Tarde would designate the science — is much more important and has been much less studied. The economic man is a two-fold abstraction. He is too narrow in interest, and too isolated in his relations, to represent the actual man of commerce and industry. Sentiment, faith, prejudice, determine the individual as really as does egoistic interest, even in economic relations. The forces of group, corporation, vicinage, religious community, are more or less influential in every bargain, or fixation of wage and salary. The sympathetic strike, practiced in 'America, the most utilitarian of countries, we are told,' is an extraordinary example of interest in the lot of others, and of the power of social solidarity. Sacrifices for an idea, for a principle, for a sympathy, have never been more conspicuous than in the field supposedly governed by economic forces.

Moreover, the psychology used has been the antiquated hedonistic psychology of the eighteenth century, which conceived man in terms of sensibility; and in the forces of sensibility the attention has been largely fixed on pain as the constraining motive to activity. Labor has been regarded as the all-important fact, whereas in certain respects leisure is the more significant. It is in the periods of leisure that social union and freedom of individual choice are stimulated. The division of leisure deserves consideration as well as the division of labor. "The less men work, the more they want to consume." Changes in the form of industry produce changes in the state of mind of the laborer; and through the varying psychical qualities of different races, new inventions permit certain races to forge to the front. Thus

the present age of machinery puts a premium on the tenacity of attention which is found in the German, English and American, while the more mobile and versatile imagination of the French and Italian workmen, which was of great value when the artistic was prized, is a disadvantage to the worker with a machine.

While, however, the complexity of economic facts and the need of psychology for their explanation are well pointed out, the author's actual success in analysis and interpretation does not meet the anticipations raised by the introduction. For the method pursued is to range the usual economic facts of production, exchange, consumption, etc., under the author's well-known rubrics of 'imitiation,' 'opposition' and 'adaptation.' In some cases no further psychological analysis is attempted. Instead we have simply a discussion, ethical or economic, as to the respective merits of individualism and socialism. It may be easily admitted that the economics of fashion and mode present phenomena of imitation, that strikes are a form of opposition, and that exchange and associations may be regarded as adaptations (indeed, what intelligent act is not an adaptation of means to ends?). The question remains whether we have added much to our scientific knowledge by grouping our facts under such general categories. To supplement its general analytic method, modern economics has resorted to the historical method. But unfortunately Professor Tarde gives little or no attention to this method. The economics which he considers is of the older, abstract type, and his psychology suffers correspondingly. If one were to apply the 'historical method' to the explanation of this, he might doubtless find a reason in the fact that French economical theory has not as yet generally responded to the new movement. A psychology which should interpret the actual development of industry and commerce, and of the various forms of economic value would have a more fruitful problem.

J. H. TUFTS.

UNIVERSITY OF CHICAGO.

The Varieties of Religious Experience, A Study in Human Nature. Being the Gifford Lectures on Natural Religion Delivered at Edinburgh in 1901–1902. WILLIAM JAMES. New York and London, Longmans, Green & Co. 1902. Pp. xii + 534.

This volume presents in full measure the characteristic features which have caused Professor James' writings to be so widely read and appreciated — an engaging style, an abounding wealth of concrete

material, a complete and sympathetic understanding of the common experiences of life, the touch of nature which makes the author kin to all his readers, and, above all, the power of acute analysis and of bold constructive generalization. The task which he has set himself in these Gifford lectures, is an inductive study of the varieties of religious experience with the purpose of ascertaining their common elements, of assessing their value, and of discovering a basis for their rational justification. He restricts the sphere of his observation for the most part to the human documents of the neurotic type, on the ground that the extreme and abnormal cases bring into high relief the essential elements of religious experience, and that the intense emotional tone of such states of consciousness emits not only heat but light as well. In this connection, he insists that religious experience should be tested not by its origin, whether under normal or abnormal mental conditions, but solely by the three following criteria: (1) Immediate luminousness, (2) philosophical reasonableness, (3) moral helpfulness (p. 18). The utility of a religious experience is after all its supreme warrant.

The author further circumscribes the field of research by the exclusion of institutional religion with its variety of creed, ritual and rubric, and by confining his investigation solely to the various manifestations of personal religion. The definition of religion in the line of this purpose is as follows: "Religion, therefore, as I now ask you arbitrarily to take it, shall mean for us the feelings, acts and experiences of individual men in their solitude, so far as they apprehend themselves to stand in relation to whatever they may consider the divine" (p. 31).

The prevailing types of religious experience fall into two classes, the so called 'once-born,' and 'twice-born' souls. The former are those fortunate spirits to whom religion is a second nature. Wordsworth perhaps had such in mind in his lines:

> "There are who ask not if thine eye
> Be on them; who, in love and truth
> Where no misgiving is, rely
> Upon the genial sense of youth.
> Glad hearts! without reproach or blot,
> Who do thy work, and know it not."

This Professor James calls the religion of healthy mindedness. The present day representatives of this class he finds strangely enough among the Christian Scientists, inasmuch as they deny the existence of evil, sin or disease, and claim that their religion is one of health

and repose. Although not an avowed adherent of the 'mind-cure' doctrines and practice, Professor James is nevertheless most sympathetic and appreciative in his estimate of this new cult. The phase of this movement which appeals to him with special force is that of its close connection with the phenomena of the subconscious life (p. 94 f).

The second class of religious experiences embraces all the 'sick souls' who need a new birth. They present invariably the phenomenon of the 'divided self,' with an accompanying consciousness of friction, struggle and a desire for some form of unification (p. 127 f). As regards this process of unification, the author discusses at length the experience of conversion, in which there is always the existence of transmarginal or subliminal consciousness (p. 189 f). In instantaneous conversions there is evidence of the more intense activity of the subconscious self. This phenomenon is always accompanied by a highly wrought emotional 'faith-state' which is characterized by a sense of peace, consciousness of the possession of truth, and of 'an appearance of newness beautifying every object' (p. 248 f).

Professor James proceeds in the next place to discuss the subject of the fruits of the religious life which appear in their most complete form as the state of saintliness. This type of character is treated in its various phases at considerable length; five chapters are devoted to it, which abound in significant illustrations of a most interesting nature. The characteristics of saintliness are as follows:

1. Consciousness of the existence of an ideal power.

2. A sense of the friendly continuity of the ideal power with one's own life.

3. An immense elation and freedom, as the outlines of the confining self-hood melt down.

4. A shifting of the emotional center towards loving and harmonious affections, manifested in an increase of charity and tenderness for fellow creatures (p. 273 f).

The practical results attending the phenomena of saintliness are summarized as follows: "Economically, the saintly group of qualities is indispensable to the world's welfare. The great saints are immediate successes; the smaller ones are at least heralds and harbingers, and they may be leavens also, of a better mundane order. Let us be saints, then, if we can, whether or not we succeed visibly and temporally" (p. 377).

Turning from the question of the utility of religious experiences which manifest themselves in the various characteristics of saintliness, Professor James next discusses the question of the intellectual justifica-

tion of such experiences. Such a justification may be either mystical or philosophical. As regards mysticism, the following conclusions are reached:

1. The mystical states carry authority for him who has them.

2. But for no one else.

3. Nevertheless they serve to break down the exclusive authority of rationalistic states, and strengthen monistic and optimistic hypotheses (p. 423 ff).

Concerning philosophy, Professor James insists that its peculiar function is not to furnish religious feeling or even conviction, but its province is critical, and inductive; and as such, philosophy is to be regarded more in the light of a 'science of religions.'

In the concluding chapter (p. 511 ff), the author states his own 'over-beliefs' in the following cardinal points of doctrine:

1. The subconscious self as intermediating between nature and the higher region.

2. The higher region, or 'God.'

3. Influences from the higher region produce real effects in nature.

In the postscript, Professor James explains his general philosophical position as based upon a pluralistic hypothesis consistent with the concrete individual experiences as the basis of religion.

Such being a very brief summary of the contents of this volume, let us turn our attention to some points of criticism. It must be remembered that while the extreme case may throw much light upon the nature of religious experience, nevertheless, the abnormal in turn cannot be adequately estimated save through the light shed upon it by the normal. The type of religious experience must lie, as is the nature of all types, midway between the extremes; and it after all represents the normal man, the great body of sane individuals whose religious experiences are no more connected with pathological phenomena than their experiences of friendship, of patriotism, or of moral obligation. Moreover, when submitted to the test of utility, the extreme case of religious experience by the very excess of its emotional vigor may defeat its own end as a social force. Professor James makes prominent the fact that 'saintly conduct would be the most perfect conduct conceivable in an environment where all were saints already, but in an environment where few are saints, and many the exact reverse of saints, it must be ill-adapted' (p. 356). The religious forces which possess in an eminent degree the capability of adapting themselves to the needs of various peoples and to various times are precisely those forces which emanate from the normal experiences

common to the vast number of inconspicuous persons who constitute the median type. These experiences are commonplace; they possess no content of mystic truth; they are accompanied by no dream or trance states, they show neither the heat nor the light of emotional enthusiasm — but they do form a steady stream of influence in every community which makes for the conservation and progress of all forms of social good. But for the historic continuity of such experiences throughout the Christian centuries, the flame of religious devotion would have been extinguished, and the occasional appearance of a hero of saintliness, or of a religious genius would hardly have served to rekindle its glow. As in philosophy the appeal is so often made to the common sense of the plain man, so also in religion the superior court of appeal resides in the common experiences, the commonplace experiences if you will, of simple conviction and quiet devotion.

Moreover, it is obvious that the common type of religious experience is found in such numbers that it can be studied only *en masse*. Now, inasmuch as institutional religion is at once the sphere of its activity and the result of its convictions, it follows, therefore, that institutional religion must be regarded in some measure at least in the final estimate of religious values in general. If there is to be a science of religion, it must deal in its inductive investigations with the various forms of institutional religion. For the critical and inductive method is not only to be applied rigorously to the varieties of personal religious experience, but it should be applied also in such a manner as to embrace the largest possible area. To omit the study of institutional religion, therefore, is to circumscribe the area of investigation in such a way as to cut off much light which might prove most illuminating. In this connection also, if the test of utility is to be applied, the common religious experiences of those who constitute the various sects of Christendom must be reckoned with. Their manifold influence upon the progress of civilization attests their value according to a standard which Professor James in this work specially endorses. Moreover, the collective efficiency attaching to groups of persons with common religious connections and concerted activities must also be considered. The utility of such a social factor is evident.

The extreme case of religious experience, again, cannot be correctly evaluated until we know its effect upon the community, the tribe, the nation, or the age in which it occurs. This effect can be estimated, however, only when we know the general level of religious experience and that in turn can be known only in reference to the prevailing religious tone of the age as evidenced in its religious institutions

and movements. Thus the significance of the individual case of personal religious experience can be adequately appreciated only in its general religious setting and historical antecedents. Professor James asserts that 'churches when once established live at second hand upon tradition, but the *founders* of every church owed their power originally to the fact of their direct personal communion with the divine' (p. 30). While it is true that great religious movements may be traced to the personal religious experience of a conspicuous leader of thought, nevertheless, on the other hand, it is quite as true that the leader is to be accounted for in a large measure by the religious atmosphere of the age in which he lives. It is but half the story to state that Luther founded Protestantism; it is also true that Protestantism produced Luther.

Turing now to Professor James' hypothesis of the subliminal region as an explanation of man's seeming consciousness of a higher power, it is insisted that divine influences may operate through this medium. The author is constrained to confess that 'just how anything operates in this region is still unexplained' (p. 270). He regards this region, however, as the probable sphere of mediation between the subjective consciousness and the 'something higher' or the 'something more' which is recognized in every religious experience. It serves to bridge the gulf between the known and the unknown, establishing an unbroken continuity between them. There still remains, however, an outstanding difficulty. This *tertium quid*, this medium of transition and communication, partakes more of the nature of the unknown than of the known. The weakest point in this chain of continuity lies in the passage from the conscious to the subconscious. It does not rationally certify the presence or indicate the nature of the divine.

In the subconscious region there may be the open door through which divine influences operate, as Professor James suggests, but it may be also the region of chimeras and delusion. As an hypothesis, it may serve to explain the divine, or equally well, to explain it away. If we trace religious phenomena to this source, the source itself is still within the shadow. If it were possible to illuminate the field of the subconscious so as to reveal in clear light the forces which are there operative, it would cease to be subconscious. Subconscious states, therefore, cannot be adduced as a *rational* justification of religious experiences. They may perform an extra-rational function, and if we are properly to estimate their evidential value, we should not fail to keep in mind their extra-rational character.

A remaining point is still to be considered. Professor James suggests that not only do we find the foundations of religious experience within the nature of the individual, but also it may be that the object of that experience may differ for each individual; in other words, every man may have his own God, the complement, as it were, of his own religious nature (pp. 525–6). Such a conception would destroy that fundamental unity which is as essential to a science of religion as it is to physical and chemical science. It must be said, however, that Professor James does not subscribe unreservedly to any such doctrine, but suggests it merely as a possibility which at least merits some consideration.

In conclusion, it is a pleasant duty to emphasize the fact that while this volume contains much that may possibly provoke differences of opinion, nevertheless it must be acknowledged that the thought throughout is so fresh, vigorous, stimulating and suggestive, that it will no doubt prove a valuable and permanent contribution to a profounder understanding of religious experience and of human nature.

JOHN GRIER HIBBEN.

PRINCETON UNIVERSITY.

The Principles of Logic. HERBERT AUSTIN AIKINS. New York, Holt. 1902. Pp. 489.

Professor Aikins has undertaken a rather difficult task in this little volume. It appears to be a double task. First to write a treatise on logic which shall serve for elementary study in colleges and at the same time to discuss subjects which more properly belong to advanced thought on the subject, and second to deviate somewhat from the traditional conception of logic and its functions. In regard to the former task I do not think that he has improved the subject for college curricula. It is hard enough in any case to get logic respected by colleges, and in the writer's opinion the reason lies in the fact that the science has been made too formal for usefulness, and postponed too late in the course. It ought to follow mathematics immediately to correct the confidence in reasoning which that science inculcates consciously or unconsciously. In that case the simplest formal rules are all that are necessary and the student can then be put to practical examples and made to test his reasoning processes. No discussion of the larger questions of logic and philosophy is necessary. For advanced students of the subject it is different. Professor Aikins hesitates between the two needs and does too much for one and too little for the other.

I do not see that his treatment of conversion and related processes and his view of deduction in any way contributes to a better understanding of logic. It only makes the subject less exact than it really is and serves but to confuse the mind as to the real nature and merits of the traditional logic. The more we discuss about its principles and rules the less likely is the student to accept them for the regulation of practice. All attempts to be original in this science only result in confusion. If the category of quantity is not satisfactory in determining formal logic I am confident that we shall have no definite rules at all by which to measure or determine an agreed standard of correct proof and communication of conviction. Let me take one example to illustrate. On page 194 Professor Aikins gives the following syllogisms with his remarks:

"Five francs are a dollar;
Four shillings are a dollar;
∴ Five francs are four shillings.

The inference is perfectly valid: but if we say in precisely similar form:

"Blades of grass are green:
Frogs are green:
∴ Blades of grass are frogs,

the inference is not valid. The reason, of course, is that the copula 'are' is used in different senses in the two syllogisms."

Now I must contend that in the first instance, according to all intelligible rules of logic the first syllogism is not valid in its inference. You have to supply a special meaning for the terms even to make it appear valid. The formal rule requires us to interpret 'are' according to the simple meaning of that term in all other propositions and not to suppose mathematical equality which it may suggest in such propositions as those in this instance. It is only in formal logic that we can get any general rules whatever. If we are dealing with material logic we have no general principles, except as we can classify them under those of material fallacies, but none whatever would exist for valid reasoning. In fact the difficulty in both Professor Aikins' examples is the same. It is not the truth of the proposition in the conclusion that is concerned, but the validity of the process of getting it, and that must be subjected to the quantitative test, or there is none. It would be merely a matter of individual opinion whether it were true or not and there would be no way to apply *ad hominem* argument.

I would agree that scientific method needs to be considered in the philosophic curriculum, but it ought to be discussed without complicating it with the questions of elementary logic.

J. H. HYSLOP.

NEW YORK.

The Elements of Experimental Phonetics. EDWARD WHEELER SCRIPTURE. Yale Bicentennial Publications. New York, Charles Scribner's Sons. 1902. With three hundred and forty-eight illustrations and twenty-six plates. Pp. xvi + 627.

The matter represented in this volume is of a much greater variety than one expects in a book on phonetics. However, the author is certainly right in expressing his opinion that the science of phonetics cannot be confined to a study of the physics and physiology of speech sounds, and that the problems of speech perception, of the psychology of language, of rhythm and verse, etc., can all be treated by experimental methods and must be included. The book, indeed, includes an enormous amount of details, even the most elementary, of every science in any respect related to the problems of speech production and speech perception. And being written in a rather popular style, without entering into any deeper discussion of contradictory theories of these auxiliary sciences, it seems to be written for any one who possesses as much as a high school education. This fact does not, of course, exclude the book from being used also by more specially trained readers. Indeed the extraordinary number of titles of books and scientific articles quoted by the author seems to prove that he had also such readers in mind. He certainly deserves praise for collecting such an amount of material. If, however, the first class of readers will be much benefited by this material in its present form of representation, seems doubtful to the reviewer. Yet this judgment is entirely subjective, and others may disagree with it.

The reviewer, while reading the book, wondered if the author could actually have read all the books and articles quoted. He feels sure that the author has not mentally digested all of them. To the naïve reader the text gives the impression to be the critical decoction of the numerous articles quoted at the bottom of nearly every page. A critical comparison of the text with the notes, however, and the enormous size of the volume too, make one rather believe that the author wrote the text partly from memory, quoting now and then the sources of his information as he remembered them, and mostly by compiling rather uncritical abstracts made by himself and others; and that, hav-

ing completed this, he had some librarian distribute the titles of the catalogue of some scientific library over the different pages of the book. A possible explanation of this would be, that the pressure of the Yale bicentennial caused abortion of the product before it was quite mature. A bibliography is a good thing, but it might prove more useful if printed as an appendix than if connected with a text which is not always its progeny. The naïve reader who for further information reads the articles quoted at the bottom of the page, will often waste much time by reading articles insignificant for the problem, and sometimes not finding at all the one which contains the best information; the latter being absent, because its title does not disclose all of its content, the former being present, because it is *entitled* to be. This criticism, of course, is not intended as a reproach to the author, but merely to warn the reader not to expect to find more in the book than it offers, although this latter is a great deal.

Part I.: *Curves of Speech.*—The author explains in detail vibratory movement, how it is produced, influenced by friction, by exterior forces like an electromagnet with an intermittent current, how it can be graphically represented. The phonautograph and manometric flames are then discussed. Both make speech visible, but imperfectly. The phonograph is then described, which is greatly superior as a recording instrument and has the additional advantage of permitting to prove the accuracy of the record by means of reproduction. The different methods of reading the phonograph record are mentioned. A description of the gramophone and of the author's method of enlarging gramophone records follows. The last two chapters of this part are on the analysis of speech curves obtained by the recording instruments mentioned.

Part II.: *Perception of Speech.*—The anatomy of the organ of hearing is illustrated by six very clear-cut figures. Aphasia, agraphia, etc., are discussed, together with the accepted theory of the action of the cortical centers. The perception of musical tones is treated in the way in which this is commonly done. The reviewer was shocked to find here the somewhat sweeping statement: 'To the mind the tone from a violin is just as simple as that from a tuning fork or an organ.' The author seems to have a general tendency to decide difficult theoretical questions by leaving the decision to the common sense. This does not please the reviewer, but it may satisfy others. Further, the perception of speech elements is discussed. More or less different sounds are perceived under certain conditions as like. Language tends to bring into prominence such elements as are necessary for dis-

tinction, and to suppress needless distinctions. In a chapter on speech ideas, the phonetic unit is distinguished from the phonetic element: a phonetic unit is a complex sound representing a single idea. It may consist of more than one 'word.' Phonetic elements are the simplest speech sounds which we are able to remember. In the same chapter are discussed visual and auditory lapses, misreadings and misperceptions of spoken words. Another chapter is on the association of ideas. The last three chapters of this part report on the results of experiments concerning association with special regard to speech. A pendulum chronoscope is described, measurements of association time are mentioned, the significance of transposition and substitution of speech elements for the development of language is discussed, methods of memorizing are compared by briefly stating the results of the several investigators.

Part III.: *Production of Speech.* — The first chapter gives a detailed description of the most important apparatus for recording muscular movements in general, particularly of the Marey drum. The second compares breathing under ordinary conditions with breathing during speech. Three further chapters give a very clear description of the anatomy of the vocal organs, including the muscles of the lips, tongue, soft palate, etc., of the action of the larynx and methods of observing it. The action of the vocal bands cannot be regarded as vibratory motion of strings or membranes, but rather of cushions of a highly complicated structure and function. The mathematical laws of vibrations of the air in cavities are mentioned and briefly applied to the cavities of the mouth, as far as this is possible at the present time. The methods of obtaining palatograms (of tongue contacts) are described and a number of palatograms of several languages are reproduced and compared. The author then discusses tongue positions and movements. He emphasizes that one should not overrate the importance of a certain position found in the production of a certain sound. This position may be of much less significance for the production of this sound than the manner in which the tongue moves to this position and away from it. Further chapters discuss the action of the pharynx, nose, velum, lips and jaw, simultaneous and successive movements of the several organs functioning during speech, and vocal control by the nervous system.

Part IV.: *Factors of Speech.* — A careful study of vowel records shows that vowels are produced by air puffs emitted from the larynx, which may be like sinusoids or more like explosive blows. The tone corresponding to the frequency of these puffs, the cord tone, varies

during a single vowel in pitch as well as in intensity. The tone (or tones) produced by each puff in the mouth cavity is, according to the Helmholtz theory, an overtone of the cord tone; according to the Willis-Hermann theory its pitch is independent of the pitch of the cord tone. The author accepts the latter theory, stating and comparing the arguments for either theory. He makes the contradictory statement (p. 420) that 'the two forms of treatment imply that the *cavity tone* is to be considered in the one case as a *free vibration* of the air in the cavity, and in the other case as a *forced vibration*.' The cavity tone is never a forced vibration; for a forced vibration of a body (or a volume of air) cannot be called a tone of this body, *e. g.*, the forced vibrations of a sheet of paper which I hold in my hand while listening to an orchestra, cannot be called the tones of the paper, but only the tones of the orchestral instruments. What the author refers to, is that according to the Helmholtz theory the mouth cavities only reënforce overtones of the cord tone, whereas, according to the Willis-Hermann theory the mouth cavities may not only, of course, do this, but also produce tones independent of the pitch of the cord tone. These independent tones then fluctuate very rapidly in intensity, because the blast from the larynx is not constant, but consists of puffs. Forced vibrations of the air in the mouth (*i. e.*, vibrations of periods greatly differing from the natural periods of the vibrating body, the air in the mouth) are a matter of course, but do not enter into this problem at all.

A further statement which does not seem consistent with the author's views is this (p. 426): "The supposition that spoken and sung vowels consist of whispered vowels plus a cord tone is an absurdity. A whispered vowel produced at the same time with a violin note does not become a sung vowel by the addition." This is no argument. The violin tone is by no means identical with the cord tone of the same pitch, since the cavities of the mouth reënforce special overtones of the cord tone, but not of the violin tone which is far away. I have taken the experiment of producing at the same time *very strong* whispered vowels (by very strong expulsions of air) plus weak violin tones and must report that the compound sounds, however imperfect the experiment is, do not seem so unlike sung vowels to warrant the author's judgment of 'absurdity.' The only argument against the above theory, which the reviewer sees, is that in whispering the blast is constant, in speaking or singing intermittent, so that the independent tones of the mouth must be of constant (or gradually decreasing) intensity in whispering, intermittent in speaking and singing.

Liquids and consonants are then discussed. Sound fusion: "Speech cannot be considered as made up of separate elements placed side by side like letters. In the flow of speech it is just as arbitrary a matter to consider certain portions to be separate sounds as to mark off by a line where a hill begins and the plain ends." Progressive change: "The various hypotheses that have been put forth as explanations of phonetic changes might be directly tested by reproducing the conditions and recording the speech results. Thus the hypothesis that the changes known as Grimm's law are the results of increasing rapidity of speech might be tested by recording language spoken at different speeds." Melody of speech: "The present chapter will be confined to a study of pitch in speech." The cord tone alone is treated as the basis of this study. "A vowel is in fact not a melody alone but a harmonized piece of music. Experimental data on this subject are almost entirely lacking." Duration: "The experiments on speech sounds have made it clear that at best the terms *long* and *short* for the vowels or syllables of a word can mean no more than that they are on an average long and short." Loudness: "Among the hundred or so English vowels that I have inspected, I have been unable to find one that can with any close approximation be considered as steady in intensity and constant in pitch. * * * It seems to be the rule in English that a vowel following a pause shall be a rising or crescendo one, and one preceding a pause shall be a falling or diminuendo one." Accent: "The one property that characterizes auditory accent is impressiveness; this may arise from increase in loudness but also from decrease, from rise in pitch but also from fall, from lengthening of the duration but also from diminution — in short from any *change* that produces a mental effect." The last two chapters discuss auditory and motor rhythm in general and speech rhythm in particular. "Since even in scanning the syllables do not have simple relations of length, it is justifiable to conclude that in naturally spoken verse the relations differ even more widely from the theoretical ones. * * * If we assume that the movements of the hand and vocal organs are executed simultaneously, we can conclude from the foregoing experiments that the point of emphasis in rhythmic speech comes before the vowel and before or in the course of the consonant which precedes the vowel. In other words, the point of emphasis in rhythmic articulation lies at the *beginning* of the movement of the vocal organs for the production of the sound."

The relative length of the four parts may be seen from the following: I.–75, II.–112, III.–211, IV.–159.

Three appendices are added: Fourier analysis, studies of speech curves and free rhythmic action.

Although the book is not in all its parts a critical digest of the matter treated in it, but leaves a large amount of the critical work to the reader, it is certainly an extremely useful collection of material to him who knows how to use it.

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Problems of Evolution. F. W. HEADLEY. New York, Crowell & Co. 1901. Pp. xv + 373.

The author of the delightful 'Structure and Life of Birds' appears before the public in the present volume as an ardent and versatile champion of the extreme Darwinian school, and certainly proves himself worthy of being enrolled among the company of English scientists, comprising Wallace, Lankester, Poulton, Meldola, Ll. Morgan, Kidd, Ball and others, who are disposed to stand by the guns of their great compatriot at a time when the biologists of continental Europe 'are half inclined to reject Darwinism' if not 'to scoff at the bridge by which the scientific world made its way to evolution over a sea of difficulties.'[1] We are of course reminded of the fate which overtook physical science during the period of Newton-worship in England, and prediction, based on historical analogy, would probably point to the more independent scientists of the continent as the sources of any further great biological advances in the immediate future. Perhaps the revival of Mendel's work, a return to experimental breeding, from which Darwin himself started, may be a partial confirmation of this prediction.

Mr. Headley has undertaken a task before which a less intrepid writer and one with less English breadth of interests might stand aghast. In the small space of 368 pages he sweeps through the gamut of biology from the mitotic division of the cell to Chinese sociology, of course only *per summa cacumina rerum* and often leaving to one side whole masses of facts that could be used very effectively in support of his views. He often displays a refreshing neglect of the enormous literature on natural selection, Lamarckism, etc., playing about his subject in short, crisp, often delightfully facetious sentences. This is a new departure and one perhaps to be commended in a general work of this kind. Even the old stock of evolutionary puzzles

[1] *Conf., e. g.*, the epithet 'Kleinigkeitskrämer von Down' applied to Darwin by a bumptious German, and the sensational title of a recent work, 'Am Sterbelager des Darwinismus.'

— the giraffe's neck, the stag's antlers, the eyes of the cave-animals, etc.— are garnished with a few fresh phrases when set before the scientific reader for the *n*th time.

The first half of the work is devoted to the problems of animal evolution (including man in his animal aspect), the second to human evolution as such. A brief introductory chapter in the first part familiarizes the reader with a very few of the main facts of cytology and embryology. Then follows a chapter on 'Heredity, Variation and Death,' which contains some valuable suggestions worth transcribing in full: "I believe that the infusorian's senility and death after multitudes of fissions is due to excessive specialization. Weismann himself suggests that the specialization of the somatic cells *may* be the cause of death in multicellular animals, the Metazoa, but he rejects it for what seem to me inadequate reasons. In the Metazoa the specialization of the somatic cells is a great advantage, while heredity is maintained by the only slightly varying reproductive cells. And we can imagine Natural Selection singling out for survival those organisms in which these two opposite tendencies were developed simultaneously; the conservative cells handing on the characters of the race; the progressive and less stable cells changing in the course of ontogeny, so as to meet the most varied demands, and then — a wonderful fact! — when once they have gained the requisite qualities, becoming conservative, and maintaining by non-specializing fission the specialities they have developed. In the one-celled animals, as I have shown, there must be the same tendencies. But the tendency to specialize must soon be fatal. An infusorian's one cell must be a Jack-of-all-Trades, or he will be eliminated. When, after multitudes of fissions, therefore, the infusorian grows senile, I believe it is because of failure to divide into similar halves — that is, to specialization. There is in fact a failure of heredity; some characters are over-represented in one half and under-represented in the other. When fission has been repeated hundreds of times it is far from wonderful if in every individual thus produced some essential character is lacking. This becomes all the more probable when we remember that the life-histories of the Protozoa and the Metazoa seem to follow parallel lines, a point which, as I have already mentioned, has been well brought out by Mr. Archdall Reid. If the cells produced by an amœba's fissions held together there would be formed a Metazoan: the period of fission in the amœba corresponds to the life of the soma of the Metazoa, which life begins with the formation of highly specialized cells. In the Metazoa amphimixis is beyond doubt a return to the

non-specializing principle. In the infusorian, then, may we not regard conjugation in the same light? Conjugation is the natural corrective of the inevitable tendency of cells to divide unequally. But in the higher animals this specialization in the soma is an enormous gain. On the other hand, very slight variations are required in the cells set apart for reproduction. For though, if the species is to succeed in the struggle with others, slight changes must constantly be originating in them, yet the animals which grow from them must not deviate *widely* from the type. One of the higher animals is, therefore, a contrivance resulting from natural selection for utilizing the two tendencies of cells — to maintain their characters when they divide, but to vary slightly. To put it more correctly, those individuals, in different parts of which these two tendencies were highly developed, have been selected for survival. But even in the somatic cells, in spite of their returning, when once specialized, to the system of equal fission, so far as equality is possible, inevitable specialization must lead to the same results that we have seen in one-celled creatures: through repeated fissions they will, at last, no longer have that combination of elements on which life depends. So that both in the Protozoa and the Metazoa we may regard fission and over-specialization as the cause of death; amphimixis and generalization as the cause of rejuvenescence. But the multicellular are in a very different position from the unicellular. For the Protozoön there is a vitalizing process possible, which may restore its youth. For the Metazoön, as a whole, there is no such magic possibility, but only for special cells set apart for reproduction; for what we think of as the individual, death is inevitable."

In the second chapter the author trains his guns on the 'Lamarckian Principle.' Indeed 'one of the chief objects of this book is to show that the Lamarckian view has no basis in fact and that it offers no explanation of animated nature.' And it is not too much to say, in language which Mr. Headley uses of one of the worsted advocates of this principle as applied to the development of floral structures, that the bones of Lamarckism 'lie bleaching before the walls.' Apart from freshness of treatment, many of the arguments are not very new. He sets forth the impossibility of conceiving of a process whereby the somatogenic modifications (acquired characters) of an organism can produce corresponding variations in the offspring developing from its germ-cells — perhaps at the present time a strong biological, but by no means a strong logical argument; the fact that the environment is impotent to change the inherent characters of an organism; the im-

possibility of explaining the colors of flowers and fruits on the Lamarckian principle; the fact that in their hearts breeders of animals and horticulturists are necessarily Weismannians; the fact that growth and development are independent of exercise; the instincts of solitary insects; the skill of the workers among social insects — an argument which is being deprived of much of its force by recent observations on ants and termites.[1]

In brief, the author believes that "when Weismann has been worsted in controversy it has often been through the cumbersomeness of his own armour rather than the skill of his adversaries. Notably has this been so when, arrayed in his elaborate panoply of biophors, determinants, ids, idants, he has tried a tilt with them on the much-vexed question of the reproduction of lost parts. When a cray-fish loses a claw, he proceeds to grow another. The salamander is celebrated for its power of replacing lost limbs. How explain this, he is asked, if the germ-plasm lives apart? Then appear the armies of determinants that he has called into being, and he marshals them, each in its place, not without difficulty. This I cannot help regarding as a self-imposed burden, as I have already said. I wish now to point out that the reproduction of lost parts should be the *bête noir* of the Lamarckian rather than of the Neo-Darwinian. For it is clear, when a lobster replaces a lost claw, that nothing external is the cause of the re-growth; the loss has merely stimulated the organism to put forth a power that belonged to it at birth, viz., the power of replacing a lost limb."

It may be remarked that the author fails to make use of some valuable anti-Lamarckian arguments, *e. g.*, those drawn from the migrations of animals in Professor Brooks' lecture ('The Foundations of Zoölogy,' pp. 108–111), and mimicry and protective resemblance are

[1] Many authors (Forel, Miss Fielde, the reviewer and others) have shown that worker ants (sometimes incorrectly called 'neuters') often lay eggs which develop into males. The reviewer believes that this is of quite frequent and normal occurrence, at least in well-established formicaries, and that it certainly opens a path for the specific characters of the workers to be transmitted through certain males to the eggs of the queens and through these to succeeding workers and queens. In a word, the 'determinants' of the workers must find their way repeatedly into the germ-track (Keimbahn) of the species. Fertile workers among bees have often been observed, and Heath and Silvestri have recently given good evidence to show that a similar condition obtains among the workers and soldiers of termites. It would seem therefore that in the well-known Spencer-Weismann controversy in regard to worker insects, both parties assumed conditions unwarranted by the facts.

not emphasized, probably because these subjects have been more fully considered by other Neo-Darwinians (Wallace, Poulton).

Chapter IV., one of the longest in the book, deals with 'Natural Selection.' In this and the following chapter on 'Sexual Selection,' the author skilfully draws on his extensive knowledge of birds, although much of the material presented is well known to the general reader. Mr. Headley is delightfully frank in dealing with the weaknesses of speculative biologists. We have seen this in the above-quoted passage on Weismann. It is also apparent when he says: 'Correlation, like Mesopotamia, is a blessed word; the evolutionist calls it to his aid when in dire distress.' The author is himself of a decidedly speculative turn and his book abounds in conjectural ways of accounting for the origins of certain adaptations, like flight in birds, lungs in the Amniotes, loss of sight in cave-animals, etc. At the present time such disquisitions have little more than rhetorical value. They remind us of the fictitious speeches in the Greek historians, and are quite in harmony with the elaborate Haeckelian 'Stammbaum,' with its gnarled and inflexible branches, reproduced on page 139. Still these chapters abound in suggestive paragraphs like the following: "The sudden loss of horns brings out a point to which, I think, attention has never been directed in discussions on pammixis. The evolution of new characters is a gradual process requiring ages of time. Geology shows that the stag's antlers have grown step by step from small beginnings. But they might be completely lost in a single generation. The horns of cattle, though less magnificent, are none the less the slow product of ages of unintermitted selection. But by a sudden freak they disappear utterly in an individual here and there, or leave only a dangling vestige attached to the skin.

"Those evolutionists who love symmetrical theories, mapped out regardless of observed facts, imagine a process of retrogression by which all the stages in the evolution of the most complex animals may be retraced in ordered succession. What actually happens is usually very different. An elaborate organ is suddenly much reduced and mutilated or suddenly disappears altogether. The wing of the apteryx has not become by reversion a reptile's fore-limb, then the fin of a primitive fish, and after these transformations slowly dwindled. Under the downy feathers is a minute avian wing, not a reptilian fore-limb or a fin; the machinery of flight has been simply reduced, and, probably not by slow degrees, reduced almost to the vanishing point, so that loss rather than reversion is the word to describe what has happened. No ancestor of the apteryx had a fore-limb similar to the ves-

tige that survives in the present representative of the line. We have here the result of a tendency that is, I believe, universal in the organic world, of heredity tending to fail and let the complex organism that evolution has built up suffer dismemberment."

Mr. Headley attributes less importance to geographical isolation and more to natural selection in the production of species than did Gulick or Romanes. Occasionally there are obvious contradictions between the facts recorded and the inferences. Thus at page 115 he calls attention to the male stickleback which 'makes a nest and protects the eggs, guarding them from his own cannibal unmotherly spouse,' whereas three pages further on he asks the question: "Why do 'water-breathing' animals, those that for respiration make use of oxygen dissolved in water, all allow the direct and pitiless incidence of natural selection upon their young?" Besides this *lapsus* he appears to have overlooked completely the Embiotocid fishes and the viviparous sharks, brilliant examples of water-breathers that shield their young from the 'incidence of natural selection.'

The principle of 'organic selection' is accepted and succinctly stated in the following words: "A congenital variation, in itself too minute to affect the question of survival, may gain selection value through exercise. The variation having thus been saved by exercise, further variations in the same direction may occur." The examples cited in support of this principle are highly conjectural and, therefore, not very forcible.

The second half of the book contains much interesting material on human evolution. There are luminous, but not necessarily very original, discussions on the evolution of race-energy and physical degeneration (considered under the captions of stature, disease, deaf-mutism, nerve-strain, alcohol), on the possible means of checking degeneration, on the roots of morality and religion and on intellectual development. A very brief summary of the author's main conclusions is given in the opening paragraph of the twelfth chapter: "I have shown or attempted to show (1) that the tendency of civilization is to reduce physical vigor; (2) that among men natural selection often fails to eliminate individuals for conduct that is ruinous to the tribe or nation to which they belong; from this failure of natural selection has resulted the evolution of morality and religion which have stepped in to save the human race from falling victims to their own vices; that now among civilized peoples evolution is working mainly towards a strengthening of the moral virtues; (3) that intellect, though there is no increase in actual brain power, is yet becoming more and more

potent, since it has at its command an ever-growing accumulation of knowledge."

The work closes with a timely study of Chinese institutions. The illustrations, confined to the first part of the book, are very meager and taken mostly from well-known text-books of zoölogy.

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Dictionary of Philosophy and Psychology. Written by many hands and edited by JAMES MARK BALDWIN, with the coöperation and assistance of an International Board of Consulting Editors. New York and London, Macmillan. 1902. Vol. II., pp. xvi + 892. $5.00 net, per vol.

In the PSYCHOLOGICAL REVIEW of March, 1902, a review of the first volume of the 'Dictionary' was presented. It was possible at that time to discuss the general plan of the work as announced in the Editor's preface, and to form some preliminary judgment of the way in which the plan had been carried out in the treatment of the topics as far as the term Law. The second volume, which appeared some months ago, contains the text from Law through Z and also contains full indexes of the foreign terms. This completes the text of the Dictionary. The third volume is to be devoted entirely to a general bibliography and will contain no further treatment of topics. It is possible, therefore, to review at this time, not only the new matter presented in Vol. II., but also the whole work as far as the text is concerned.

The second volume is a much bulkier book than Vol. I. There are 828 pages of text in Vol. II. as compared with 644 in Vol. I., and in addition, Vol. II. contains 75 pages of indexes. This difference between the sizes of the volumes is due in part to the large number of important topics which naturally fall in the second half of the alphabet.

The articles under P, for example, cover 152 pages. The longest articles under this letter are as follows: 'Patristic Philosophy' (5 pages) by Professor Shanahan; 'Philosophy' (6 pages), by Professor Dewey; 'Probability' (9 pages) by Professor E. W. Davis and Professor F. Franklin; 'Proposition' (9 pages), by a number of writers, but chiefly by Mrs. C. L. Franklin, and 'Psychology' which is given under a series of subtitles and covers nine pages.

The articles under S cover 176 pages. The longest articles are: 'Space' (6 pages), by Professor Gardiner; 'Speech and its Defects'

(11 pages), by Professor Jastrow, with remarks by the Editor; 'St. Thomas and Roman Catholic Theology' (4 pages), by Professor Shanahan; 'State' (5 pages), by Professor Bosanquet; 'Syllogism' (11 pages), by Mrs. C. L. Franklin and Dr. C. S. Peirce, and 'Symbolic Logic' (10 pages), by Professor Couturat, Mrs. Franklin and Dr. Peirce.

Without attempting to describe in detail the scope of each letter, mention may be made of the longer encyclopedic articles which have not been referred to in the lists above given. One of the most valuable articles in the dictionary is the article on 'Vision' (26 pages) written by a number of contributors and presenting very clearly and fully the status of present knowledge on the subject.

The 'Nervous System' is treated in an article 13 pages in length by C. L. and C. J. Herrick. There are also articles on localization, and on the spinal cord, in this volume. When it is remembered that the longest article in Vol. I. was on the brain, we see that the nervous system has been treated at great length in the work. The treatment is, furthermore, very comprehensive and clear. The most obvious criticism on this series of articles is that the distribution of matter under the various titles does not seem to have been very carefully planned. For example, the article on brain frequently overlaps the article on nervous system. To such an extent, indeed, is this true that one cannot read the one article without referring to plates in the other. Furthermore, there is no reference whatever in the article on localization to the work of Flechsig, and the table of reflex centers in the spinal cord is given, not under the title spinal cord, but under nervous system.

'Variation' (8 pages), 'Uniformity' (5 pages), 'Organic Selection' (4 pages), 'Origin versus Nature' (6 pages) and other related topics are very fully discussed by various contributors and the Editor. Under 'Selection' a table is given by the Editor classifying the various forms of selection and stating the essential characteristics of each form.

'Oriental Philosophy' is treated in an article 23 pages in length by Rev. J. E. Carpenter, of Manchester College. In this article Egypt, Babylonio-Assyria, Persia, India and China are discussed. Religion is discussed with reference to its evolution, its philosophy and its psychology by Professors Ormond, Wenley, Baldwin and others.

Other special topics are 'Optical Illusions' (8 pages), by Professor Sanford; 'Time' (6 pages), by Professor Gardiner.

This array of encyclopedic articles in the second volume accounts, as has been said, in some measure for the greater bulk of this volume

as compared with the first. But closer examination of the articles convinces one that the plan of the work has undergone an internal as well as external enlargement as later stages have been reached.

Thus, there is a clear disposition to give Greek philosophy a fuller recognition. An article on Schools of Greece has been inserted which reviews in a general way all phases of Greek thought and deals in extenso with the Epicurean and Stoic Schools. It is a very desirable article for such a dictionary. It seems to be somewhat crowded out of place when it has to work its way in under the obscure heading Schools, but it is certainly better late than never. One will regret that the article on Epicureanism in the first volume could not have been correlated in any way with this later article by even so much as a reference forward. And one will be disposed to question a plan of dictionary making which allows two independent discussions of Epicureanism and no special article on Stoicism. But some minor lack of uniformity in the methods of attaining the full purpose of the work is doubtless due to the difficulty of planning in detail for every phase of such an extensive undertaking.

Again, one must note that the second volume has followed the negative rather than the positive method of curing the biography. There are only one half as many biographies in the second volume as in Vol. I. Here again alphabetic conditions explain in part, but only in part, the difference.

The second volume is much freer than was the first from terms which have no direct relation to the main purposes of the book. It was possible to mention at random under any one of the letters in the first volume irrelevant terms, but one will find very few such terms in the second volume.

The complete use of the foreign terms in the Dictionary is now made possible by the addition to this volume of Greek, Latin, German, French and Italian indexes. So far as the researches of the present reviewer have extended, these indexes are complete and accurate. There is need for a similar index of the leading English terms. The dictionary contains a great deal of valuable material which will not be easily accessible to the ordinary student because it is distributed under widely separated headings. Even the cross references between topics do not fully direct the reader in his search for these discussions. An English index like the indexes of foreign terms would do much to remedy this difficulty and would reduce the whole work, encyclopedic articles and shorter dictionary articles alike, to a much more uniform standard of accessibility.

From this description of the second volume and this comparison with Vol. I., we turn now to a more general view of the work as a whole. As pointed out in the discussion of the first volume, the present reviewer must leave the evaluation of the topics outside of the field of psychology and its immediately related subjects to those who are competent to pass judgment in those spheres. It is possible for the psychologist, even though he look through the dictionary in a casual way, to recognize in many of the departments outside of his own clear-cut, consistent lines of thought running through the dictionary. The various articles on the philosophy of religion, on æsthetics, on epistemology, and on other general groups of subjects, all furnish good illustrations of what can be done in the way of preparing critical statements on current topics in these fields.

Turning now to the psychology presented in the dictionary, we have a most valuable and highly instructive exhibition of the present conditions within our science.

In the first place, one becomes conscious during a critical examination of the dictionary that there are many terms which are not capable of any universally acceptable definition. This appears in some cases in the fact that the writers of the dictionary articles have found it necessary to record divergent usages. It appears also in many cases in the fact that the recorded usages do not include those which are to be found in works of standard authority. The terms which belong more especially to experimental psychology are, as one would naturally expect, capable of briefer and more precise definition. The terms which are broad and general in their connotation have not yet been brought to the same clearness and definiteness as the terms of corresponding scope in the physical sciences. Indeed, in the dictionary articles one frequently finds that there is a disposition to try to force agreement in spite of the obvious impossibility of securing agreement. The article becomes in every case of this kind a piece of special pleading. The psychological position of the author is aggressively brought to public attention. All this is legitimate and valuable if the dictionary is to be put on an equal footing with other elaborate discussions of psychology, but it leaves the student without the settlement of many of the problems which a large board of authorities coöperating in the critical sifting of usages was expected to furnish. The dictionary will lose its highest value, will indeed be in frequent cases positively misleading, if it is appealed to as a final authority on current usage of terms, if by current usage we mean the usage of all the leading authorities.

One illustration must suffice to make clear the meaning of these statements. Take the definition of the all-important term mind as it is given for psychological usage. Mind "in psychology" is "the individual's conscious process, together with the dispositions and predispositions which condition it. It is thus the individual's consciousness, with its capabilities; its capabilities including all faculties, powers, capacities, aptitudes, and dispositions, acquired and innate." Certainly this definition with its emphasis upon the term individual is wholly inadequate to cover either the spirit or letter of Wundt's statement, "es ist einleuchtend, dass in ihm (diesem empirischen Sinne) die 'Volksseele' genau mit demselben Rechte eine reale Bedeutung besitzt, wie die individuelle Seele eine solche für sich in Anspruch nimmt." (Völkerpsychologie, Vol. I., Pt. I., page 9.) Or again, to quote from Sully: "In addition to such wide and varied observation of individual minds, the objective study of psychical phenomena should include manifestations of products of the collective mind, that is to say, of the mind of the community or society * * *" ('Human Mind,' Vol. I., page 20). Furthermore, even when the word mind is used to apply to individuals rather than to communities, certainly it is common to emphasize in some sense, not merely the existence of consciousness, but its unity, its organization into a single system. Mind is not to be set over against consciousness as its synonym merely; mind means all of consciousness, but it means especially the combination of all phases of consciousness into one. As Ward has put it: "In psychology, on the other hand, the individual mind may mean either (1) the series of feelings or 'mental phenomena' above referred to; or (2) the subject of these feelings, for whom they are phenomena, or (3) the subject of these feelings or phenomena plus the series of feelings or phenomena themselves, the two being in that relation to each other in which alone the one is subject and the other a series of feelings, phenomena or objects" ('Encyc. Brit.,' XX., 39).

One can hardly refrain from expressing the wish that 'mind in psychology' had been included in the list of subjects to receive more extended encyclopedic treatment.

Recognizing, then, the chief psychological articles as discussions, rather than as final statements of authority, or even as exhaustive reviews of usage, we find it interesting to note the clear tendencies which many of these articles exhibit.

The majority of the elaborate psychological discussions are written by the Editor and Professor Stout. Both writers exhibit a marked interest in the genetic aspects of the subjects which they treat. Indeed,

throughout the dictionary one finds constantly recurring evidences of the great influence of the principles of evolution and development on all our present-day thinking. This is perhaps one of the strongest and most important features of the work. The discussion of psychological topics from this point of view promises much for the future of the science. The work that Professor Baldwin and Professor Stout have already done along the lines of genetic psychology is here presented in new and often more compact form than in their earlier writings.

The close relation between psychology and biology in all of its branches, is fully recognized by the dictionary. Indeed, the superficial observer will form the impression, because of the long encyclopedic articles on brain and nervous system and other anatomical and physiological topics, that the work is one in which physiological psychology gets unusually full recognition. This first impression will be somewhat modified when one considers that the purely psychological discussions are much more numerous, though frequently shorter, and that the material on brain and nervous system has been massed at a few points. But even with this mode of distribution clearly in mind, the reader will find no cause to change his view that physiological psychology is adequately treated.

The relation of psychology to the social sciences has been fully recognized. Indeed, under the heading Social Science the Editor has given a table of classification in which the various social sciences are distributed with obvious regard to their relation to psychology and philosophy.

The discussions of abnormal psychical processes, most of which are written by Professor Jastrow, present their subjects from the point of view which Professor Jastrow has always adopted in his writings on these subjects. That point of view can be briefly characterized by the statement that it is itself eminently sane and free from any lack of clearness. There is no tendency in all these articles to depart from the more general mode of thought which is everywhere recognized as appropriate to normal psychology.

In concluding this description of the text of the dictionary it is appropriate to repeat the expressions which are called out by the first volume. The dictionary is a work conceived on a large scale and brought to completion in a manner thoroughly creditable to editor, contributors and publishers. It is the only book of its kind in our language, and it will doubtless exercise a large influence on the future of psychological science and psychological terminology. It is stimulating to students and workers in the fields which it covers, and where

one is not fully in accord with the details of the plan on which the book was prepared, or with the conclusions reached by the contributors, he will at least find much valuable material here at his immediate disposal for reflection and for use in balancing his own views.

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GENERAL.

Zur Lehre von den Allgemeinbegriffen. G. STÖRRING. Philosophische Studien, Zwanzigster Band (Festschrift, Theil II.). Leipzig, 1902.

General concepts (Allgemeinbegriffe), or concepts as such, must first be distinguished from general images (Allgemeinvorstellungen). There is really no such thing as a general image, in the usual sense; every image of a triangle must, as Berkeley claims, be either right-angled or oblique-angled, etc.; in other words, the general image, commonly so-called, is really nothing but a single image. A single image may, however, represent a number of completely similar objects; or, if vague, it may be applied indifferently to several dissimilar objects, as when the child calls different objects by the same name, without distinguishing them. But this is quite different from a concept; the latter is applied to different objects which are at the same time distinguished. The question arises, then, what part is played by the single image in the conceptual process? The answer is that its function is representative (stellvertretend). The representative image stands out against other similar single images lying in the background of consciousness. But the first stage of the conceptual process is not the recognition of this similarity but the analysis of content and relations found in the representative image. Then, by association, through a common content, with the other images present, it becomes representative of a class and thus converts the process of analysis into a conceptual process. Since the image must also be differentiated from each image of different content, it is evident that a number of negative judgments are necessary to render the conceptual process complete. But the last is true only of more complex images; the concept of a simple content-element requires merely an analysis of this element out of the whole content; and that of a simple relation presupposes only an identical judgment (A is A) in which the relation is posited. The author concludes with a reply to Volkelt, who claims that a concept can never be complete because completeness would include an intuitive apprehension of the whole

content of the object, — the concept indicating merely the *direction* of the thought. According to our author, it contains in itself the complete thought, and the direction referred to is merely that of the development of the image.

Eine Willenstheorie vom voluntaristischen Standpunkte. N. Lossky. Zeitschrift für Psychologie und Physiologie der Sinnesorgane, Bd. 30, Heft 1 u. 2. Leipzig, 1902.

The paper begins with a preliminary definition of voluntarism and its method. Voluntarism is the theory which holds that the typical form of conscious process is voluntary activity — that within the Ego there are no static (bleibenden) states, but only purposive activities; its method, therefore, is to take the obvious instances of voluntary activity as its point of departure for the analysis of mental life as a whole. Upon this basis we then distinguish the following: (1) *My* impulse, (2) the feeling of *my* activity, (3) the changes brought about by my activity. (1) We must distinguish between my impulses and those that merely occur in my consciousness (mir gegeben). The latter orginate many of the acts of my own body; for example, the drunkard holding the glass in his hand may drink as the result of an express determination, or merely mechanically, without really taking the matter into consideration. Only those impulses which I will to satisfy are properly mine. But, again, this willing may be spontaneous or forced upon me. We must, therefore, distinguish three grades in the voluntary character of our activities; *my* (spontaneous) decisions, forced decisions, and acts not deliberated upon and hence not the result of a decision. But for a complete definition of what is properly mine it must be noted that the impulses included in the activity are not all clearly analyzed; some of them are below the threshold of consciousness and the total motive, as far as these are concerned, is an unanalyzed impulsive feeling. Ultimately, moreover, no impulse has a separate object of its own; what we discover is that each is but a function in a continuous process of purposive activity. (2) The feeling of activity is ultimate and unanalyzable — not resolvable into either muscular sensations or sensations of innervation. (3) The changes following the impulse also vary in the degree to which they are 'mine.' There is my inner act, in which I create wholly new combinations of images; my partially internal act, in which the new combinations are due partly to external suggestion; and my external act, which means merely that a movement of my body follows the appearance of an impulse. With regard to the last-named, it is the object to be attained,

and not the movements themselves, which constitutes the content of the impulse, and therefore the movements as such are not truly mine. All phenomena of consciousness may then be resolved into three classes — 'acts of will,' or my acts, 'acts in me,' the result of impulses opposed to mine, and 'states of consciousness,' not connected with impulse. But, according to the author, this distinction is ultimately a distinction of degree only. Every mental process contains a certain measure of given material. Whether it is 'mine' or simply 'in me' depends upon its nearness or remoteness to the focus of attention. This is determined by the extent to which the given material is acted upon by the impulses which I identify with myself and accompanied by the feeling of self-activity — nothing which enters consciousness being altogether free from these influences. The voluntaristic theory holds then that every conscious process, so far as it is apprehended as mine, has all the essentials of a voluntary act and is determined by the impulses identified with self.

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Some Examples of the Use of Psychological Analysis in System-making. MARGARET FLOY WASHBURN. Philosophical Review, XI., 5, Sept., 1902, pp. 445–462.

Dr. Washburn summarizes, compares and discusses the different methods of analysis and the consequently different conceptions of 'attribute' and of 'element' which underlie the psychological classifications of Wundt, of Ebbinghaus, and of Münsterberg.

The method of analysis adopted by Wundt and by Ebbinghaus may be termed 'psychological'; it is the 'method of calling mental phenomena elementary because they are the simplest phenomena that, as capable of being *experienced apart* from each other, may be attended to separately (p. 453).' Miss Washburn rightly, however, criticises both writers in that they insufficiently distinguish this method of analysis from a second — that employed by the writer of this review,[1] 'the method of calling mental phenomena elementary because they are the simplest phenomena that, being independently *variable*, may be attended to separately.'

On the basis of the first of these principles of analysis Wundt, as is well known, (1) classifies psychical elements as sensations and feelings, and (2) endows these elements with the 'attributes' of qual-

[1] 'An Introduction to Psychology,' 1901, Chap. viii.; this REVIEW, July, 1900, p. 378 *seq.*

ity and intensity. On the first of these procedures, Miss Washburn remarks (p. 454) that while often claiming a psychological ground for the classification, Wundt really emphasizes the epistemological basis of it, in the teaching that the psychical elements correspond 'to the two factors contained in immediate experience, the objective contents and the experiencing subject.' With reference to the second point, Miss Washburn infers (p. 457) "that Wundt means by the attribute of a sensation a character that does not spring from the togetherness of sensations, and that is not even influenced * * * by * * * the mental context." On the basis of the first of these criteria, she agrees, Wundt rightly excludes extension and duration from the class of attributes (she fails here, as Wundt does, to take account of the sensationalistic conception of bare 'extensity'— distinct from form). But Miss Washburn objects to the exclusion of 'vividness' from the class of attributes; vividness, to be sure, is affected by the 'mental context,' but so also, she argues, is the 'quality' of sensations. Wundt's classification of feeling, finally, is subjected to less fundamental criticism; but it is rightly urged that, by his own standards, pleasantness and unpleasantness should be ranked as feeling-qualities rather than as feeling-directions.

Ebbinghaus recognizes three groups of psychic elements, sensations, ideas and feelings. But his 'ideas' are merely 'centrally excited sensations' and have — as Miss Washburn points out — no real right to be classed as distinct psychic elements. Sensations, Ebbinghaus further teaches, have attributes of two sorts: specific and generic. "Specific attributes * * * are those * * * which no two classes of sensation possess in common; they are generally grouped under the two heads of quality and intensity, but these names do not refer to any real sameness among qualities and intensities themselves, only to two kinds of relation to the stimulus. * * * On the other hand, the generic attributes are actually and in themselves identical for different classes of sensations (pp. 458–459)." These generic attributes are: extension duration, movement, change, similarity, difference, unity and plurality.

It is thus evident that Ebbinghaus conceives of the generic attribute as "any conscious content which is so far dependent upon sensations that it arises only in connection with them, and is yet a bit of immediate experience not an artificial product of the transformations of thought." In the opinion of the present writer, Miss Washburn is justified in her basal criticism of this position. All the generic attributes, she points out, "except duration and extension would by most authorities be called independent bits of conscious con-

tent (p. 459)." They have, in fact, as good a right as the 'feelings' to be classed as elements of consciousness. A second criticism is implied in the quotation just made. The generic attributes, as enumerated, are extremely heterogeneous in character: both extension and duration should, in fact, be reckoned with the specific attributes.

The analysis at the basis of Münsterberg's psychological classification is of two sorts; and Miss Washburn points out that the two methods are not thoroughly coördinated. Münsterberg employs, first, "as * * * criterion of an element, that it is the final stage of a *parallel* analysis of mental state and physical stimulus" (p. 451). From this point of view he holds that the sensation is the only psychic element, on the ground that "the physical stimulus in the outer world can not be dissolved any further without ending the mental effect." But Münsterberg further uses "the method based on the assumption that because similarity between complexes involves partial identity, all similarity is partial identity and is between complexes" (p. 454). From this assumption he infers that sensations, because similar, are complex not elemental, and that they are made up of elemental 'psychic atoms.' On the first of these methods Miss Washburn remarks: "The notion of what constitutes a physical analysis needs to be made more precise * * * or we have gained nothing by demanding a parallelism (p. 451)." As a matter of fact, she points out (p. 456), the conception of the sensation as the only psychic element is based by Münsterberg on epistemological rather than on psychological grounds. "Nothing but sensations can be allowed in the scheme of elements because only sensations correspond to distinguishable parts * * * of objects; and only by relating our mental states * * * which we alone can know, to objects which are accessible to others, can we accomplish the second main purpose of analysis, besides explanation, namely description." In Münsterberg's second system of analysis Miss Washburn disputes the premise that similarity always is partial identity. The similarity of concepts, she argues, is rightly so described, but absolutely simple sensations as well as concepts may be similar (p. 453).

Münsterberg's classification of sensational attributes ('qualities' as he calls them) is three-fold. He distinguishes (1) content qualities (kind, intensity and independence), (2) form qualities (with the two main heads, space-form and time-form) and (3) value qualities, which "represent epistemologically the attitude of the subject." Miss Washburn holds that "the term 'quality' is not used in the same sense for the three classes. Content qualities," she says, "seem really to be attributes belonging to the sensation element, in the ordinary sense,

that of independently variable aspects." Form qualities, on the other hand, described as themselves possessing kind, intensity and independence, are 'as a matter of fact sensational elements.' The value qualities, finally, are closely parallel with Ebbinghaus's group of 'generic attributes.'

Different readers will draw widely different conclusions from Miss Washburn's clear exposition and discriminating criticism of these three theories. To the present reviewer, for example, it seems perfectly clear that the difficulties in the way of the three methods of analysis, employed by Wundt, by Ebbinghaus and by Münsterberg, are avoided by that other method which defines the element as the 'independent variable' and recognizes qualities, intensities and extensities as themselves sensational elements. Similarly, the inconsistencies in Ebbinghaus's treatment of 'generic attributes' and the ambiguities in Münsterberg's enumeration of 'qualities' suggest to the writer the need of a class of 'relational elements'—immediate consciousnesses of likeness, difference, one-ness and the like, the analogues of Ebbinghaus's generic attributes (extension and duration, excepted) and of a group of Münsterberg's value qualities.

But, however the specific deduction varies with the individual reader, the practical outcome of the paper is the same for all—a persuasion of the need for greater uniformity in psychological method and in definition. "The differences," as Miss Washburn says in her concluding paragraph, "in these three systems of psychology are due to different conceptions of the nature of analysis, * * * [of] the relation of an attribute to that on which it depends, * * * of the relation between epistemology and psychology. * * * If agreement could only be reached on these three points, two of which are mere matters of definition, it would certainly be a most important advance in psychological method, and a valuable saving of time now wasted in dispute about words."

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Classification of Psychical Phenomena for Experimental Research. TOULOUSE, VASCHIDE ET PIERON. Mind, N. S., No. 44, Oct., 1902, pp. 535–537.

This paper proposes a 'practical classification' of psychical phenomena, 'especially intended for experimental work' and completely freed from the traditions of 'classical psychology.' In truth, however, this scheme of classification is based throughout on theoretical

considerations. Its recognition of 'sub-conscious' as well as of 'conscious' sensations is mainly founded (p. 536, p. 540 *seq.*) on Leibniz's law of continuity. Its conception of the complexity of sensations involves the doctrine — abundantly refuted by James, by Külpe and by many others — that psychical and physical complexity are completely parallel. Its treatment of 'affinity' — a conception covering what are generally known as association and apperception — is a mere restatement of the dogma of associationism.

In more detail, the writers distinguish the 'internal' and the 'external' sensations as sub-classes of 'the conscious sensation or elementary psychical phenomenon'; and they enumerate (p. 537) as the 'fundamental and irreducible characteristics' of all states of consciousness (1) intensity, (2) affectivity, (3) objectivation, and (4) affinity. It is obvious that these characteristics are utterly heterogeneous. 'Intensity,' moreover, is treated not only in its ordinary meaning of sense-intensity, but also as 'personal intensity,' to include both attention and memory. It is certainly confusing to use the word in both these senses; and, furthermore, the conception of 'personal intensity' is far from clear. There is, of course, a significance to one school of psychologists, in the description of attention and memory as peculiarly personal sorts of consciousness, but Toulouse and his colleagues define personality as 'complete synthesis' or aggregation of ideas, and from this point of view memory seems no more 'personal' than perception.

Opinions may differ on the value of the classification proposed, but it can not seriously be maintained that it offers any new or any consistent principle of division; and it is inconceivable that experimental psychology should be in any special manner the gainer from it.

Einleitung in die allegemeine Theorie der Mannigfaltigkeiten von Bewusstseinsinhalten. GOTTL. FRIEDR. LIPPS. Philosophische Studien, Festschrift, 1902, II. Theil, pp. 116–151.

Lipps sets out from the conception of thought-activity and thought-object (*Denkthätigkeit und Denkgegenstand*), as implied one by the other, and strictly correlative. The term 'thought' is apparently used as synonym of 'consciousness.' He goes on (§ 6) to distinguish the thought-activity as either (1) mere apprehension (*Erfassen*) or as (2) relation (*Beziehen*). Corresponding with these, in the domain of object-of-thought, he names (1) the content-of-consciousness (*Bewusstseinsinhalt*) and (2) substance, the substratum (*Träger*) of cause and effect. These two, however, he insists, are separated not in reality but only through abstraction (p. 132), so that exclusive reality

can be attributed to neither one. "Therefore," he says (pp. 133–134), "neither the world of contents-of-consciousness nor the world of substances exists for itself alone, but rather both together, interwoven as they are, form the one real world of the objectively existent."

The most interesting application of this doctrine is to the problem of the classification of the sciences. "The natural sciences (pp. 134–135) belong without question to the doctrine of substances, for every nature-object exists as substance (*besteht substanziell*)," that is, as center of forces. Psychology, on the other hand, in the modern sense of the science of what one feels and knows, is the study not of soul-substance but of conscious contents.

The closing sections of the chapter, which compare the simple with the complex object-of-consciousness, are not very closely connected with the rest. They include (1) a forcible exposition of the truth that simplicity or complexity of the conscious content does not imply simplicity or complexity of the bodily accompaniment; (2) a conventional analysis of the content-of-consciousness into quality and extensity; (3) an attempt — unsuccessful in the opinion of the present writer — to show that simplicity and complexity are merely relative terms and that, consequently, all supposedly simple conscious contents are analyzable. From this follows the possibility of a 'psychical atomism' like that advocated by Münsterberg, who, however, is not named here.

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Physiological Factors of the Attention Process. (I.) W. McDOUGALL. Mind, N. S., No. 43, pp. 316–350.

The writer starts on the assumption that the psychological facts in connection with attention are already pretty thoroughly known and that what is now lacking is to supply the physiological basis for those facts. This he believes to be as completely wanting as the psychological factors are supplied.

The earlier pages of the work are devoted to a brief *résumé* of the current theories. Most of this portion of the paper is devoted to a drastic criticism of Münsterberg's *Aktionstheorie*.

The author's own theory is an application of his neurin hypothesis, published in *Brain* last year. Briefly, nervous action is pictured as the flow of a hypothetical fluid, neurin, through afferent and efferent fibers from sense organs to muscle plates. The flow is checked and regulated by the varying resistances of the synapses, which are pictured as valves that work only in one direction. There are said to

be four levels on which these connections may be made, although the writer has a most irritating way of naming but three wherever he gives a specific enumeration. The three levels are the spinal and subcortical connections, the points of connection in the sensory areas of the cortex and the association areas of Flechzig. Each higher level is distinguished from the lower by an increase in the number of paths which may be taken, and in the complexity of the connections.

Differences in the direction of the attention mean merely the opening of different paths of connection in the cortex between sensory and motor areas. When an indistinct sound is interpreted as the clucking of a hen one series of connections is open, when later it is found to be the cry of a hawker at a distance there is another set open. All differences reduce to a question of the channel that the nervous impulse may happen to take. Not only attention, but all of what James calls the substantive states of consciousness are explained as due to these higher level paths. The transitive states are provided for by assuming that there are collaterals which connect the various paths of the same level and permit crossing from one to another.

The author promises to discuss the problems as to why the neurin takes the high level paths at all, and why one rather than another, together with the fact of fatigue and of the mutual exclusiveness of the paths, in later articles. Until it is seen what success is had with these crucial questions, it is not possible to criticise the theory, but as it stands it seems very schematic, to have slight basis in fact, and if true to offer no advantages in definitiveness or simplicity over the familiar theories of the day.

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VISION.

Der linear-perspectivische Factor in der Erscheinung des Himmelsgewölbes. GEORGE M. STRATTON. Zeitschrift f. Psych. u. Physiol. der Sinnesorgane, XXVIII., 42–45.

In opposition to von Zehender's contention that the flattened appearance of the clouded sky is explained by the physical facts of the eccentricity of the observer's position within the cloud sphere, Stratton holds that the most important factor in the explanation is visual, and depends on the general laws of perspective.

Die scheinbare Vergrösserung der Sonne und des Mondes am Horizont. EUGEN REIMANN. Zeitschrift f. Psych. u. Physiol. der Sinnesorgane, XXX., 1–38 and 161–195.

The first part of Reimann's paper is historical. Beginning with Aristotle it gives a detailed account of the various hypotheses that have been offered in explanation of the apparent enlargement of the heavenly bodies at the horizon.

The second part is theoretical and critical. At the outset the author takes the discussion onto a higher plane than usual by seeking a quantitative expression of the illusion. Measured in terms of the distance at which a white disk must be viewed in order to appear equal in size to the sun, the apparent size of the sun at the zenith was found to be related to its apparent size at the horizon as 38.11 to 11.47. The ability to explain this enormous difference is made the test of the hypotheses. The change in direction of the line of regard is shown by simple experiments to be altogether inadequate. Comparison of the sun with terrestrial objects is likewise shown to be inadequate. Of the theories depending on changes in the apparent distance, the exaggeration of divided distance and the influence of aërial perspective are both dismissed without discussion as unsatisfactory. The apparent shape of the sky, on the other hand, is accepted as the real ground of the illusion. By measuring the real elevation of the apparent middle point of an arc connecting the zenith with the horizon, it is found that the apparent length of the horizontal radius of the sky is from three to four times the length of the vertical radius. This relation is confirmed by astronomical observations on meteors, and it coincides fairly well with the changes in the apparent size of the sun. It is Reimann's effort to show that this apparent flatness of the sky dome is not a mere illusion which in turn demands an explanation, but a fact based on simple optical laws. In a murky atmosphere, the more distant objects are obscured, as it were, with a gray wall. In the clearest weather the same limitations to vision are still present, only they are further removed and changed in color from gray to blue. This wall is always relatively nearer at the zenith in cloudy weather because of the position of the opaque cloud stratum; in clear weather, not because of any real interference to vision, but because in the higher strata of air there are relatively few particles capable of reflecting light enough to penetrate the denser lower strata. The highest point from which the light of the rising sun is reflected to the earth in sufficient quantity to be visible is about 15 km., while the greatest distance at which mountain peaks are visible in clear weather averages about 50 km. These facts agree both with the apparent relative distances of the zenith and the horizon, and with the apparent changes in the size of the sun and moon, and they are consequently held to constitute an

adequate explanation of the illusion. The psychological difficulties involved in the assumption that we have direct visual data for the comparison of such enormous distances are not discussed.

Ueber das räumliche Sehen. E. STORCH. Zeitschrift f. Psych. u. Physiol. der Sinnesorgane, XXIX., 22–43.

From the field of psychiatry, Storch always brings interesting and valuable data to the discussion of psychological problems. But his unusual indifference to the history of his problems, as well as to the results of previous discussions, seriously detracts from the pertinence of his contributions. Storch contends that the monocular visual form yields no definite spatial perception of form, but includes innumerable possibilities, constituting a 'visual concept' which becomes definite only through experience. "Concerning the real distance and size of objects binocular vision can teach us no more than monocular." "Depth exists as sensory stimulus only for touch." The indefinite visual factor must be supplemented by the sum total of the spatial perceptions, which arises through the other senses, and for which the visual factor is a symbol. The Müller-Lyer figure, the Poggendorff, and other illusions are offered as illustrations and proof of the influence of the depth factor in the visual perception of plane figures.

RAYMOND DODGE.

SPEECH FUNCTIONS.

Unfähigkeit zu lesen und Dictat zu schreiben bei voller Sprachfähigkeit und Schreibfertigkeit. C. RITTER. Zeitschrift f. Psych. u. Physiol. der Sinnesorgane, XXVIII., 96–130.

Without entering into the bearings of his case on the problems of the psychology of reading, the author limits himself to a painstaking, if sometimes tedious, examination of what we would call a high-grade imbecile, who presents an unusual form of defective linguistic development. The patient, a healthy man, twenty-six years old, can name most of the letters of the alphabet at sight; but, notwithstanding ordinary schooling, he has never been able to read them combined as words. He can copy without gross errors but is unable to write anything from dictation except his own name. Numerals, however, as our general knowledge of the differences between them and words would lead us to expect, are correctly read as wholes into the tens of thousands.

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Studies of Melody in English Speech. By E. W. SCRIPTURE. Philosophische Studien, XIX., 599–615, 1902.

This contribution of Professor Scripture to the volumes of the *Studien* published in honor of Wundt's seventieth birthday, throws a side light on the author's elaborate investigation of phonetics. Dr. Scripture supplements the important work which he has done in measuring the pitch and intensity variations of speech in curves traced from gramophone plates, by here measuring the record of sentences spoken into a mouthpiece connected with a Marey tambour. Unfortunately we have no record of the same sentences spoken into the gramophone. A comparison of the two methods would offer a valuable check on the reliability of the gramaphone for registering the voice. It is quite likely that the sounds are changed by the resonators of any phonographic instrument. We would like to know if the changes are sufficient to disturb the records for the purposes to which they are put. So far as the cord tones of the voice are concerned, it is probable they are not. We may judge from the present paper that Dr. Scripture found no differences in the records made under the two methods which were sufficiently great to cause him to suspect the accuracy of the results previously published from the gramophone.

"In the melody of speech," Dr. Scripture finds, "we have a partial record of the emotional expression of the speaker." Tables of measurements and plotted curves are given for eleven short sentences which express emotions accompanying command, interrogation and exclamation. In the gramophone records the fundamental form of pitch for the declarative sentence was shown to be a circumflex melody. The variations from this are traced for each of these new sentences. The records are for the voice of Dr. Scripture himself and were taken at the Collège of France, Paris, on apparatus of the Abbé Rousselot. The curves bear out those of the Jefferson toast made on the gramophone in the fact that the variations in tone are found not to be great, rarely reaching an octave. The presence of sonant 'h' as well as a surd 'h' is again demonstrated. Dr. Scripture finds opportunity to criticise certain statements in Sweet's 'New English Grammar' regarding the intonations of the English language. The presence of a circumflex melody in either isolated words or in sentences used to express surprise is shown by the records, while Sweet states that for single words thus used there is a steady rise in pitch and for sentences there is a fall. Emphatic words were also shown to have this rise and fall of pitch. The sentences for which the measurements are given were taken from examples in Sweet's Grammar, so we are

making some progress toward an empirical examination of language problems which have been tossed back and forth for years with little hope of solution until they could be taken up in the laboratory. It is pleasant to note that the work of Dr. Scripture on phonetics is being further carried forward, an appropriation having been made by the Carnegie Institute partially to meet the expense incurred.

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SPACE.

Die Dimensionen des Raumes. A. KIRSCHMANN. Philosophische Studien, Bd. XX. (Wundt's Festschrift), I. Theil, S. 310–418.

This essay of more than a hundred pages is the most pretentious contribution to the first of the two Festschrift volumes. The reader is convinced early that this is a careful piece of critical work, displaying the results of wide reading, close thinking and a general overhauling in a refreshingly sane way of some of the fundamental spatial concepts. The style of the article is usually clear and at times forceful, though lapsing occasionally into a diffuseness that detracts much from the power of presentation. The value of the essay lies in the most commendable attempt to reach some sort of clear understanding in regard to the qualitative nature of space, whether this space be that of the psychologist, the philosopher or the mathematician. The discussion that such an attempt involves is both needed and welcome, particularly in view of the fact that the lay mind, and that of some others besides, is so readily mystified by the usual arguments for a fourth dimension, and in view too of the uncritical attitude of many mathematicians who accept with ill-concealed wonder and amazement the flat contradictions between the spatial characteristics disclosed by pure intuition and those arrived at through the current analytic methods. We must frankly express our gratification that the matter has been handled by one whose equipment in the various fields mentioned is sufficient to enable him to speak with authority.

Our author is a thorough-going intuitionist in this space matter. It is of the immediately given space alone that we have any right to speak. The space of our intuition is the sole space that we can attempt to analyze and characterize, from whatever point of view we may make our approach. As the best mode of procedure toward his proposed task the author selects for the main topic of discussion the problem of the dimensions of space. Is the generally accepted tri-dimensional

character of space obviously and necessarily drawn from the nature of space itself, or is it a mere conventionality adopted in the interests of demonstration or quantitative reckoning? This must be answered by every one who strives towards clearness in the use of spatial concepts.

In the first place, one must be clear about the fact that magnitude and extension are two utterly different matters. The latter only belongs originally to the space concept. The former is an imported characteristic, implying first measurement, and then intensity through which alone measurement is possible. Theories of space and theories of magnitude must therefore be kept unmistakably asunder.

The main discussion is preceded by a review of the several motives operative in producing hypotheses of a fourth or of higher dimensions. These are four in number. *First*, there is the mystically minded person who demands a fourth dimension of space for the explanation of such operations as are illustrated by the performances of Slade before Zöllner. A space is desired in which tri-dimensional knots may be united and in which egg-shells may be turned inside out without doing violence to the laws of cohesion. *Second*, psychological doctrines of space perception, though contributing no positive plausibility to the assumption of higher dimensions, seem often to imply that such higher dimensions are perfectly possible. To the partial nativists who hold that the third dimension is the product of inference, or at least a construction not immediately given, and to the empiricist who 'forcibly evolves space from non-spatial elements' there should be nothing impossible or contradictory in the thought of four or more dimensions. *Third*, the attempt of natural science to establish thorough-going causal connections in its world of fact is thwarted in at least one direction. Enantiomorphic forms and movements resist all thought of transformation from one to the other. No simple causal connection can exist between the right- and left-handed movements of the particles of such substances as sugar solutions and oil of turpentine. For only qualitatively similar movements can be transformed into each other. But the assumption of a fourth dimension would furnish an escape from this difficulty. For, by the well-known analogies, the right-handed form need only be turned through the fourth dimension to make it congruent with its left-handed companion. The *fourth*, and most influential motive has sprung from the side of mathematics. The belief in hyper-space has been fostered, if not overtly supported, by the distinctions advanced between Euclidean and non-Euclidean spaces, by the speculations of Helmholtz, Riemann, Klein and others to which expression has been given in the terms curved

hyperbolic and elliptical spaces, and by the alleged analogies between algebraic powers and spatial dimensions. The practice of mathematicians to distort terms from their accepted meanings into a terminology applicable to new speculations has done much to introduce confusion and to make the mathematician appear to mean what he would not maintain if cross-questioned.

Clearness, then, and harmony between those fields wherein the concept of space is current can be best secured, the author thinks, by a critique of the definition of dimension. The various meanings of 'dimension' may be briefly passed in review. First, that meaning which is contained in the expression 'an n-dimensioned manifold' is properly applicable only to a manifold of independent variables and has nothing to do with the actually given space. 'N-dimensional space' is only an unsuitable and misleading expression for a manifold of n independent variables. — Similarly, that notion of dimension is unsound which springs from the practice of forming a correspondence between dimensions and the powers of variables. For the prosecution of the analogy requires the assumption of perpendicular coördinates, which assumption is not based upon the nature of the immediately given space. — Nor can that definition of dimension be upheld which makes of it a fundamental *direction* in space. For the choice of the directions and their relation to one another are purely conventional matters. Eliminate the condition of perpendicularity from this convention and any number of fundamental directions may be chosen to serve as axes of coördinates. That is, the number of the dimensions of space may be as great as one pleases. For simplicity's sake only are the usually chosen coördinates and dimensions to be preferred. — The only definition that can stand the test of scrutiny is to be couched in terms of *boundaries*. For this is founded upon the space intuition. On this view the dimensions of space are merely the *grades of determinateness possessed by spatial forms*. The order of this determinateness is then expressed by the series — solid, surface, line, point. In a general sense the first dimension is just 'unlimited space extending in all directions,' the simplest and most primary deliverance of our space intuition. If confined within limits, however, the limiting form, or surface, appears as the second dimension. Successive limitations give us then, further, the line and the point, making four dimensions in all. The point is in no way the 'space-element,' nor is it in any sense non-spatial. It is rather the most thoroughly determined of all the spatial forms.

It is clear that no thought of *direction* is contained in this notion

of dimension. Accordingly, this point of view is not practicable for the purposes of mathematical analysis. For these purposes the author freely admits that the usual Cartesian coördinates are the most serviceable. Only one must remember that the choice of the directions and their relation to one another are arbitrary and conventional, in no way corresponding to the real nature of space.

As to the number of dimensions, if we use the rectangular Cartesian coördinates, with full conciousness of the conventional character of our procedure, we may be sure that a 'fourth dimension' is an absurdity. If we surrender the rectangular relation and use as axes of coördinates any arbitrarily chosen directions from a given point, we may then raise the number of 'dimensions' to any degree that we choose, while if we adopt the approved conception of dimension given above, we may speak with perfect propriety of four dimensions, but no more. In any case the point to be urged is just this, that whatever notion of dimension we choose to adopt for purposes of analysis or what not, we must make clear to ourselves the relation between this notion and the real nature of space, and be convinced that we have therein no possible warrant for the assumption of a non-Euclidean or an extra-empirical space.

Many interesting and cleverly handled side-issues occur here and there in the course of the essay. These may be passed by here with a mention of one only. The Wundtian doctrine of local signs is frankly confessed to be faulty in so far as it attempts to reduce the spatial to the purely intensive or qualitative. It leaves nothing to be desired, however, in so far as it explains the spatial *arrangement* of our sense impressions.

Ueber die Auffasung einfachster Raumformen. RICHARD SEYFERT. Philosophische Studien, Bd. XVIII., S. 189–214.

The author's former article under this same title was noticed in this REVIEW some years ago (Vol. VI., p. 447). The experiments there described dealt with the *subjective* factors in the apprehension of simple triangular forms. And the conclusion there reached was that the sensations coming from the movements of the eyes constitute the decisive factor in the accurate apprehension of these forms. The present article supplements and completes the other by dealing with the *objective* factors in this process of apprehension. The same ten typical triangular forms were again made use of here, only they were presented under the several conditions secured by heavy or light outlines, together with unemphasized or clearly marked vertical points,

and by variations in size, distance, color and illumination. The procedure of the subjects was in all cases to contemplate the figure for a given time and then by free-hand drawing to reproduce it in its actual size. The deviations of the drawn from the actual figures were measured by the sum of the deviations of each angle from its copy.

The results of the experiments may be summarized as follows:

Strongly marked outlines and clearly indicated vertical points are conducive to correct apprehension of form.

A colored form is in general more correctly apprehended than one drawn in the ordinary fashion. Still it is not so much the color itself as the brightness contrast between the colored form and its background that constitutes the advantageous factor.

For the best results size and distance must be so related that the entire retinal image falls within the limits of the yellow spot.

Disadvantageous factors are color contrast between form and background, faulty illumination, fatigue, æsthetic dissatisfaction, and the absence of the advantageous factors noted above.

Certain regularly recurring errors were noted. There was a marked tendency to make all reproduced lines shorter than those of the copy, a tendency springing, the author thinks, from an overestimation of the reproduced lines because of the summation of muscular sensations from eye *and* hand and arm. The vertical dimensions of the reproduced forms were regularly made too small — an expression of the general tendency to overestimate vertical extents.

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NEW BOOKS.

La Théorie de l'Émotion. W. James. Trans. with Introduction by G. Dumas. Paris, Alcan. 1903. Pp. 158. Fr. 2.50.

Contains translations of Professor James' chapter on 'Emotion' from the *Principles of Psychology* — with the addition of certain passages from his original article in *Mind*, IX., 1884 — and also of the article 'The Physical Basis of Emotion' from The Psychological Review, September, 1894.

Life in Mind and Conduct. H. Maudsley. London and New York, Macmillans. 1902. Pp. xv + 444. $3.50.

L'Année Psychologique. A. BINET. 8e Année, 1901. Paris, Schleicher. 1902. Pp. 757. Fr. 15.

Contains the usual quota of leading articles and reviews of literature for the year 1901, and also the bibliography of the *Psychological Index.*

Addresses and Proceedings of the National Educational Association. Minneapolis Meeting. 1902. Pp. viii + 1021. University of Chicago Press.

The usual *mélange* of things important and otherwise. It is a pity that the more authoritative papers can not be selected out for publication apart from the proceedings, lists of members, etc. J. M. B.

Human Nature and the Social Order. C. H. COOLEY. New York Scribners. 1902. Pp. viii + 413.

L'Art et la Beauté, Kalliklès. L. PRAT. Paris, Alcan. 1903. Pp. 285. Fr. 5.

A theory of art and beauty put in the form of Platonic dialogues.

Stad Antwerpen. Paedologisch Jaarboek, 1902–1903 (3d and 4th year.) M. C. SCHUYTEN, Editor. Nederlandsche Boekhandel, Antwerp; also Schleicher, Paris. Pp. 485. Fr. 10.

Each paper in this Dutch year-book of the Antwerp Paedological Society is followed by a *résumé* in French. The book contains abstracts of important publications of the year, as well as original papers.

Five Years' Observations and Experiments (1896–1901), on the Bionomics of South African Insects. GUY A. K. MARSHALL, E. B. POULTON, and others. From Trans. Ent. Soc. Lond., 1902, Part III., Nov. Pp. 287–584.

Contains a most interesting mass of material, with studies by Marshall and Poulton 'chiefly directed to the Investigation of *Mimicry* and *Warning Colours*,' and an 'Appendix Containing Descriptions of New Species.' In this connection we may also call attention to Professor Poulton's lecture on 'Mimicry and Natural Selection' reprinted from the *Proc. V. Intern. Zoologencongr. Berlin*, 1901 (1902).

Agnosticism. R. FLINT. New York, Scribners. 1903. Pp. xviii + 664. $2.

History of the Problems of Philosophy. P. JANET and G. SÉAILLES. Trans. by A. MONAHAN; edited, with an introduction, by H. JONES. London and New York, Macmillans. 1902. Two vols. Vol. I., *Psychology*, pp. xxvii + 389. Vol. II., *Ethics*, *Metaphysics*, *Theodicy*, pp. xiii + 375.

La Logique morbide. I. *L'Analyse mentale.* N. VASCHIDE and CL. VURPAS. Preface by TH. RIBOT. Paris, Rudeval. 1903. Pp. xxviii + 268. Fr. 4.

The first volume of a series to be devoted to what the projectors call *logique morbide* — defined by M. Ribot in his introduction — and sufficiently characterized here by the topics of the volumes proposed, *i. e.*, *analyse mentale*, *syllogisme morbide*, *émotion morbide*, *crtation intellectuelle morbide.*

J. M. B.

NOTES.

THE Carnegie Institution of Washington has issued a circular announcing the revival of the bibliography of medical literature, called the *Index Medicus.*

WE regret to announce the death of the eminent psychiatrist, Professor v. Krafft-Ebing, of Vienna.

THE publishers, Messrs. Houghton, Mifflin & Co., announce a new edition of the *Cosmic Philosophy* of the late Dr. John Fiske, with an extended 'Introduction' by Professor Josiah Royce, of Harvard University—to appear at once.

PROFESSOR E. F. BUCHNER, formerly of the School of Pedagogy of New York University, has been appointed professor of philosophy and pedagogy in the University of Alabama.

WE note that among the desirable things mentioned by the various authorities in Oxford, when asked for suggestions, a department of experimental psychology was brought forward by 'several.' We hope this desideratum may soon be realized. The suggestion recalls the fact that psychology has recently been recognized by Oxford in certain signal ways. The first American appointee to the Romanes lectureship was a psychologist — not only the first American but also the first psychologist to be appointed. The first honorary degree in science ever given by Oxford University was bestowed upon an American

psychologist. In Oxford itself psychology is coming forward in the work of Dr. Stout and in the broad sympathy and direct recognition on the part of the zoölogists — notably Professor Poulton. Indeed, Oxford graduates now resident elsewhere are representing the subject with distinction — witness Alexander, Hobhouse, and Titchener. England seldom remains long in a secondary place in any experimental science; and it is very singular that experimental psychology has had to wait so long for adequate support there. It is undoubtedly due to the difficulty of getting new subjects into the universities. For some time at least none of the Rhoades scholars can work in experimental psychology. Perhaps this is one of the subjects in which the demand created by the Rhoades scholarships may stimulate to the supply of facilities for research in the university.

Psychologists should note the establishment of Research Assistantships by the Carnegie Institution of Washington. Details and conditions of application may be had by request (marked 'Research Assistantships') to the Carnegie Institution, Washington, D. C.

We regret to announce the death, on January 24, of Professor J. O. Quantz, of the chair of Psychology in the State Normal School, Oshkosh, Wisconsin.

PROFESSOR J. MARK BALDWIN has engaged to give a course of lectures on 'Organic and Mental Development and Evolntion' in the Chicago University Summer School, June 15 to July 22.

It may be remarked that the present issue of the REVIEW is increased by twelve pages, beyond the usual maximun, in order to accommodate the Proceedings of the American Psychological Association. We note that a New York Sub-section of the Association has been formed. It held its first meeting in New York City on February 23.